STAR

FEBRUARY 23, 1969

VOLUME 7 • NUMBER 4

N69-13901—N69-15019

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Scientific and Technical Aerospace Reports, Volume 7, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by the Technical Information Services Company.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

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AVAILABILITY OF NON-NASA DOCUMENTS

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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **595**

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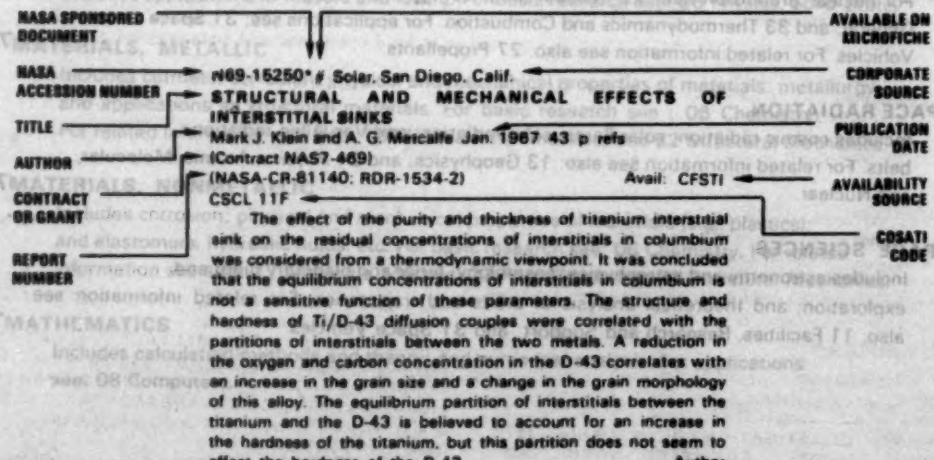
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N69-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2)
Avail: CFSTI
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N69-13949 Pittsburgh Univ., Pa.
THE LIFT COEFFICIENT OF A THIN, JET-FLAPPED AIRFOIL IN GROUND EFFECT
Joel Earl Peterson (Ph.D. Thesis) 1967 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-4401

Thin airfoil theory methods are applied to the problem of the jet-flapped airfoil in ground effect. The airfoil and the jet are represented by vortex distributions placed on the x-axis between zero and one, and one and infinity. The method of images is used in order to make the ground streamline a straight line. Before the method of images is applied a straightforward method of handling the plain jet-flap case is first developed. This method uses Fourier Series and properly picked functions which aid convergence for both the airfoil and jet vorticity. The downwash equations then give a set of simultaneous equations the solution of which is the set of Fourier coefficients. After these results are checked against other theories the effect of the ground, that is, the inclusion of the image airfoil and jet, is added on. Two techniques are used for the ground effect, one involving an approximation (Taylor Series) and the other being exact (numerical integration). Dissert. Abstr.

N69-13997# College of Aeronautics, Cranfield (England).
ON THE LONGITUDINAL DYNAMIC STABILITY OF A GROUND EFFECT WING
P. E. Kumar 1968 21 p refs
(COA-AERO-202) Avail: CFSTI

An investigation was made into the longitudinal dynamic stability of a wing in ground effect using a free flight radio controlled model and results from quasi-steady wind tunnel tests. The full equations of motion of a ground effect wing were determined but their application to stability analysis was restricted to the treatment of the linearised problem using instantaneous derivatives. Analogue simulation of this simplified analysis proved promising. It is concluded that the model in its latest form was still unstable in pitch and needed further development. Author

N69-14000*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF A LARGE JET TRANSPORT MODEL EQUIPPED WITH AN EXTERNAL-FLOW JET FLAP
Lysle P. Parlett, Marvin P. Fink, and Delma C. Freeman, Jr. Washington Dec. 1968 86 p refs
(NASA-TN-D-4926) Avail: CFSTI CSCL 20D

A wind tunnel investigation was carried out to determine the aerodynamic characteristics of a model of a large jet transport aircraft equipped with an external-flow jet-augmented flap. The tests were conducted in the Langley full-scale tunnel by using a model powered by scaled nitrogen-driven, fan-jet engines. The results of the investigation were analyzed for the case of an airplane having a thrust-weight ratio of 0.30 for both takeoff and landing. These results indicated that the model with the external-flow jet flap could achieve a maximum trimmed lift coefficient of approximately 4.0 with this thrust-weight ratio. When this maximum lift coefficient was examined with consideration of reasonable operational safety margins based on flight experience with several powered-lift airplanes, it appeared that a safe operational approach lift coefficient was about 2.2. Based on this analysis, it appeared that the use of the jet flap would provide increases in operational lift coefficient of the airplane and would give substantial improvements in takeoff and landing performance. Static longitudinal stability and trim could be achieved over the entire lift range by the use of a horizontal tail with an area of 22 percent of the wing area. The out-of-trim moments caused by operation with the critical engine out could be trimmed throughout the entire lift range by the use of conventional rudder, aileron, and spoiler controls. Author

N69-14001*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORY FOR COMPUTING SPAN LOADS AND STABILITY DERIVATIVES DUE TO SIDESLIP, YAWING, AND ROLLING FOR WINGS IN SUBSONIC COMPRESSIBLE FLOW
M. J. Queijo Washington Dec. 1968 78 p refs
(NASA-TN-D-4929) Avail: CFSTI CSCL 20D

A method of computing span loads and some of the resulting aerodynamic derivatives for wings in sideslip, yawing, and rolling flight is derived. The method is applicable to wings of arbitrary planform, and accounts for compressibility effects. The span-load computations require that angle-of-attack span-load distributions be available for the wing under consideration. The theory developed is a consistent approach, based on the use of a vortex system, for determining the various wing parameters. Author

N69-14008*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE STAGE EXPERIMENTAL EVALUATION OF VARIABLE GEOMETRY GUIDE VANES AND STATOR BLADING. PART 3: DATA AND PERFORMANCE FOR VARIABLE CAMBER GUIDE VANE AND STATOR A
S. A. Jones and R. P. Oscarson 4 Dec. 1968 152 p refs
(Contract NAS3-7604)
(NASA-CR-54556; PWA-FR-2638-PT-3) Avail: CFSTI CSCL 20D

Tests were conducted with a 0.5 hub/tip ratio compressor stage comprising a variable camber inlet guide vane, rotor, and an adjustable trailing edge stator to determine the extent that these variable geometry features can be applied to extend the stable operating range of axial flow compressors. The stage was designed for zero prewhirl at design equivalent rotor speed at sea level takeoff (SLTO) and 35- to 20-degree (hut/tip) prewhirl at 70% of design rotor speed (high Mach number cruise conditions). The design performance goals for the SLTO and cruise configurations were met. Comparing the two configurations, the cruise configuration permitted stable operation and good efficiency at lower flow for a given rotor speed than the SLTO configuration. Author

N69-14076*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF BLEED-SYSTEM BACK PRESSURE AND POROUS AREA ON THE PERFORMANCE OF AN AXISYMMETRIC MIXED-COMPRESSION INLET AT MACH 2.50
Bobby W. Sanders and Robert W. Cubbison Washington Dec. 1968 33 p refs
(NASA-TM-X-1710) Avail: CFSTI CSCL 21E

Two bleed geometries that had about a 2.75 to 1 ratio in total porous area were tested with different bleed-exit areas to provide various back pressures. With bleed-exit areas providing the same supercritical bleed mass flow, the higher porous-area configuration provided higher total-pressure recovery at critical inlet operation. For the same supercritical bleed mass flow the more porous configuration also obtained a reduction in bleed drag of 42.5 percent but at a complete loss of subcritical stability margin. However, by proper control of the bleed-exit areas, the engine corrected airflow could be decreased 13.18 percent from that at critical operation without incurring an unstart. Author

N69-14087# Royal Aircraft Establishment, Farnborough (England).
SPECIAL FEATURES OF SUBSONIC FLOW PAST WINGS OF COMPLEX PLAN-FORM [OSOBENNOSTI RASCHETA OBTEKANIYA KRYL'EV SLOZHNOI FORMY V PLANE PRI DOZVUKOVYKH SKOROSTYAKH]
S. M. Belotserkovskii Apr. 1968 13 p refs Transl. into ENGLISH from Mekhan. Zhidkosti i Gaza (USSR), no. 6, 1966
(RAE-LIB-TRANS-1297) Avail: CFSTI

The present stage of the development of aviation is characterized by the application of wings of complex planform with discontinuities in the slope of the leading and trailing edges, with curvilinear edges, with a geometry which changes in flight (due to the turning of the cantilever). Details are given concerning the calculation of the overall and distributed aerodynamic characteristics of such wings at low and high subsonic speeds. The methods based on the theory of lifting surfaces and on the use of discrete vortex properties makes it possible, with the help of the vortex circulation method, to determine the flow past the type of wing mentioned for moderate angles of attack with sufficient reliability and effectiveness. Author

N69-14211*# General Motors Corp., Indianapolis, Ind. Allison Div.
EXPERIMENTAL INVESTIGATION IN AN ANNULAR CASCADE SECTOR OF HIGHLY LOADED TURBINE STATOR BLADING. VOLUME 1: ANALYSIS AND DESIGN
James L. Bettner Washington NASA Dec. 1968 169 p refs
(Contract NAS3-9404)
(NASA-CR-1219) Avail: CFSTI CSCL 21E

An analytical and experimental program was initiated to investigate the application of boundary layer control concepts to highly loaded turbine stator blades in an annular cascade. A plain blade was designed which forms the performance base line for the program. Four boundary layer control concepts were investigated—vortex generators, tangential jet blowing, tandem airfoils, and jet flap. The stator blades were designed to a suction surface diffusion factor of 0.4. Author

N69-14262*# Techtran Corp., Glen Burnie, Md.
LAMINARIZATION OF THE BOUNDARY LAYER ON A WING PROFILE BY MEANS OF DISTRIBUTED SUCTION [LAMINARIZATSIYA POGRANICHNOGO SLOYA NA KRYLOVOM PROFILE POSREDSTVOM RASPREDELENNOGO OTSASYVANIYA]
A. D. Tokhunts Washington NASA Dec. 1968 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidk. Gaza (USSR), no. 2, 1968 p 117–121
(Contract NASw-1695)
(NASA-TT-F-12021) Avail: CFSTI CSCL 20D

Laminarization of the boundary layer on a wing profile is investigated by means of distributed suction on the basis of Prandtl's equations and the general theory of hydrodynamic stability. The effects of various aerodynamic and geometric characteristics of a profile on the minimal flow rate of evacuated air is also examined. Specific examples for the calculation of the aerodynamic and geometric characteristic and minimum flow rate of evacuated air are shown. Author

N69-14289*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A MATHEMATICAL ANALYSIS OF SUPERSONIC INLET DYNAMICS
Ross G. Willoh Washington Dec. 1968 45 p refs
(NASA-TN-D-4969) Avail: CFSTI CSCL 21E

An approximate mathematical analysis of supersonic inlet dynamics is presented. The subsonic duct is subdivided into constant-area sections which are represented by one-dimensional wave equations. The movable normal shock is used as the upstream boundary condition, and a choked station is assumed for the downstream boundary condition. The analysis leads to a closed-form matrix solution for the shock-position transfer function. Analytical results are presented and compared with experimental data. Author

N69-14331*# Scripta Technica, Inc., Washington, D. C.
ROTATING STALL IN AXIAL COMPRESSORS [COLLOQUE SUR L' AERODYNAMIQUE INTERNE DES TURBOMACHINES]
J. Fabri NASA Dec. 1968 32 p refs Transl. into ENGLISH from the French Rept. ONERA, TP-492, 1967 35 p
(Contract NASw-1694)
(NASA-TT-F-11765) Avail: CFSTI CSCL 21E

If the stall zones are represented as cells of stagnant fluid, i.e., of a fluid water, an axial velocity of almost zero, the rotational velocity of these cells can be related with the static pressure rise (due to nonstalled blades) between two successive stall zones. The condition of radial equilibrium of these bubbles permits defining the critical flow rate of which this mode of operation becomes steady. Application of the theory to a turbine rotor with solid body blading for which the increase in pressure is calculated by means of convenient assumptions about frictional and off-design losses, permits a precise description of normal operation and rotating stall conditions in the terms of the general separation in the flow. It is also shown that, for a free vortex blading, the stall cells cover only a fraction of the blade span—at least, when the hub-tip ratio of the compressor is small. Author

N69-14364# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MINIMUM RESISTANCE OF TAIL SECTIONS [O MINIMAL'NOM SOPROTIVLENII KORMOVYKH CHASTY TEL]

Yu. D. Shmyglevskiy *In its* Fluid and Gas Mechanics 25 Jul. 1967 p 18–23 refs (See N69-14362 04-12)
Avail: CFSTI

Study of the minimum wave resistance exerted by bodies in supersonic flows has been undertaken up till now only for the streamlining of a single surface. It is known, however, that it is possible to reduce the resistance of a vehicle by the introduction of additional bodies which do not protrude beyond the given overall dimensions. This study presents a hypothetical structure shape and proceeds to develop the necessary equations to measure minimum wave resistance. Author

N69-14385*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BACK FLOW FROM JET PLUMES IN VACUUM
Norman T. Grier Washington Jan. 1969 20 p refs
(NASA-TN-D-4978) Avail: CFSTI CSCL 20D

Approximate calculations were performed to determine the increase in particle density at points surrounding a jet nozzle due to the exhausted gas in the jet plume. The calculations were made for helium, argon, and nitrogen for a nozzle throat radius of 1 cm. The chamber density ranged from 10^{-8} to 1 g per cc. The plume flow is assumed radial with the source point at the nozzle exit on the nozzle axis. Author

N69-14552 Lehigh Univ., Bethlehem, Pa.
AN INVESTIGATION OF THE VELOCITY FIELD IN THE SPACE BETWEEN A ROTATING DISC AND A PARALLEL STATIONARY WALL WITH AND WITHOUT RADIAL INFLOW
Robert Andrew Conover (Ph.D. Thesis) 1967 319 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 68-4878

The laminar velocity field between a rotating disc and a stationary disc of the same diameter is investigated by means of a pulsed dye technique without thru flow and in the presence of radial inflow. A stability limit for steady laminar flow is experimentally determined as a function of disc Reynolds number and the ratio of gap width to disc radius for the no thru flow case and for a thru flow rate of 0.31 cfm. The basic steady state data is presented as a series of paired photographs, a top view and a side elevation, of a dye stream pulsed at a known rate. Numerical evaluation of the radial and tangential components of velocity from photographic data is made at selected points along the edges of the dye fan, where the axial location of the dye can be most accurately determined. The experimental data suggests three types of flow patterns. For no thru flow a cell occupies the entire gap. The velocity at all points within the gap has an axial component directed toward the disc. Dissert. Abstr.

N69-14566*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN OF SUPERSONIC INLETS BY A COMPUTER PROGRAM INCORPORATING THE METHOD OF CHARACTERISTICS
Bernhard H. Anderson Washington Jan. 1969 118 p refs
(NASA-TN-D-4960) Avail: CFSTI CSCL 20D

A FORTRAN IV computer program which incorporates the method of characteristics was written to assist in the design of supersonic inlets. The computer program was written with the intention of studying many types of inlet configurations with a minimum of computer time. Particular attention was given to a discussion of a reformulation of the boundary value problem to introduce throat Mach number and flow angle as direct program input quantities. Comparison between the computer results and experimental data indicates good agreement for a number of different configurations. Author

N69-14643# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Deputy for Engineering.
AIRCRAFT AND PROPULSION OPERATIONAL CONSIDERATIONS RELATED TO INLET DESIGN
Frederick T. Rall, Jr. Apr. 1968 37 p Presented at the 31st AGARD Flight Mech. Panel Session Meeting, Gottingen, Germany, 13–16 Sep. 1967
(AD-677193; SEG-TR-67-56) Avail: CFSTI CSCL 1/3

Diagnostic tests of the effects of mounting an inlet on the side of a fuselage and under a wing were conducted in a wind tunnel. Full-scale engine tests were conducted to investigate the effects of inlet turbulence on a turbojet. Tests conducted in an altitude facility, which incorporated a choked venturi to provide turbulence, showed that inlet turbulence reduced the engine stall margin. Wind-tunnel tests of an underwing inlet, including the inlet control system, showed the effects of inlet unstart on the stability and control characteristics of a supersonic aircraft. The effect of inlet unstart is a major design parameter in the placement of the propulsion system. Author (TAB)

N69-14666# Mechanical Technology, Inc., Latham, N. Y.
TURBOMACHINERY RESEARCH FOR NUCLEAR SYSTEMS. PART 1: FEASIBILITY OF PROCESS-GAS LUBRICATION FOR HIGH-TEMPERATURE TURBINE-DRIVEN MACHINERY. PART 2: AERODYNAMIC PERFORMANCE OF A GAS-BEARING TURBOCOMPRESSOR OPERATING IN A CLOSED BRAYTON CYCLE LOOP
P. W. Curwen and J. S. Meacher Jul. 1968 226 p refs
(Contract AT(30-1)-3237)
(NYO-3237-10; MTI-68-TR-5-Pts-1&2) Avail: CFSTI

Results of a program to determine the feasibility of applying gas lubricated bearings to high temperature machinery are presented. A brief summary of application areas is presented along with discussion of benefits likely to accrue from the applications. Feasibility demonstration is accomplished using a 24,000 rpm gas bearing turbocompressor. The steady state and transient aerodynamic performance of the turbocompressor is summarized. NSA

N69-14711# National Aerospace Lab., Amsterdam (Netherlands).
SYMMETRICAL SUBSONIC POTENTIAL FLOWS AROUND QUASI-ELLIPTICAL AEROFOIL SECTIONS
J. W. Boerstoel 20 Mar. 1968 39 p refs Supported in part by Neth. Aircraft Develop. Board (NIV)
(NLR-TR-68061U) Avail: CFSTI

The results of the computation of fifteen symmetrical non-lifting quasi-elliptical airfoil sections in steady sub-critical and critical potential flows are presented. These results are exact in the sense, that no approximations have been made in the potential theory, and that the errors in the results are of numerical nature only. The results are summarized in figures and tables. The figures permit a rapid appraisal of the overall properties of the sections. Detailed information is available in the tables. The precision of the tabulated material is sufficient for the manufacture of accurate aerodynamic test models or for accurate calculations by methods for the computation of pressure distributions in steady potential flows. The data presented can therefore serve as a reference for the testing of approximate methods. Author

N69-14717# Politecnico di Torino (Italy). Istituto di Meccanica Applicata.
STALL PROPAGATION IN A CASCADE OF AIRFOILS
Carlo Grillo-Pasquerelli Jul. 1968 35 p refs
(Grant AF-EOAR-28-68)
(AD-677167; AFOSR-68-2306; TN-46; SR-10) Avail: CFSTI CSCL 13/7

The report is a theoretical approach to the study of the rotating stall in blade rows of axial compressors. An ideal straight

cascade of infinite length is considered, its aerodynamic coefficients in incompressible stationary flow are assumed known against angle of upstream flow from axial direction, also in the field of angles larger than the stalling one. The blades are infinitely small and infinitesimally spaced. By these conditions, velocity of stall propagation, length to pitch ratio of stall cells, mean values of stream velocity and angle of flow inside and outside stall cells, and pressure ratio from upstream to downstream of the cascade, can be calculated. Author (TAB)

N69-14742# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, e.V., Brunswick (West Germany). Institut fuer Flugmechanik.

THREE-COMPONENT MEASUREMENTS WITH PARACHUTE MODELS FOR THE DETERMINATION OF THE STATIC STABILITY [DREIKOMPONENTENMESSUNGEN AN FALLSCHIRMMODELLEN ZUR ERMITTLUNG DER STATISCHEN STABILITAET]

K.-F. Doherr Mar. 1968 80 p refs In GERMAN; ENGLISH summary Supported by BMV
(DLR-FB-68-50) Avail: CFSTI

Three-component wind tunnel measurements were carried out with models of the stabilization parachutes "Ribless Guide Surface", "Ringslot", "FIST", and "Kostelezky" in order to determine their static stability. The increase of the momentum coefficients plotted versus the angle of attack serves as a measure for the static stability of the parachutes. In addition, the distribution of the resulting aerodynamic force was determined. Author

N69-14762*# Kansas Univ., Lawrence. Engineering Sciences Div.

WIND TUNNEL INVESTIGATIONS OF VORTEX BREAKDOWN ON SLENDER SHARP EDGED WINGS Final Report

William H. Wentz, Jr. and David L. Kohlman 27 Nov. 1968 120 p refs
(Grant NGR-17-002-043)
(NASA-CR-98737; FRL-68-013) Avail: CFSTI CSCL 01A

Systematic wind tunnel investigations of vortex breakdown were conducted on sharp-edged delta and modified delta wing with sweep angles from 45° to 85° at Reynolds numbers of about 1×10^6, utilizing a schlieren system for flow visualization. Vortex breakdown positions are presented as a function of angle of attack and sweep. Results agree well with the limited amount of previously published data. For the very slender wings (75° to 85° sweep), initial breakdown was nearly independent of sweep, a result not anticipated by extrapolation of previous data. Lift measurements show that Pohlhamus' leading-edge suction analogy provides an excellent means for predicting lift for wings with sweep angles between 65° and 80°, at angles of attack below vortex breakdown. For very low sweep (<65°) and very high sweep (>80°) less than theoretical lift is achieved. The reasons for these discrepancies are discussed in some detail in the paper. Author

N69-14786# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

MEASUREMENTS IN A WIND-TUNNEL OF THE DRAG OF THE REAR PARTS OF AIRCRAFT MODELS

Christian Soulier 1968 7 p In FRENCH; ENGLISH summary Presented at the 30th Meeting of the Supersonic Tunnel Assoc., Columbus, U.S.A., 3-4 Oct. 1968 Submitted for publication
(ONERA-TP-633) Avail: CFSTI

The weighing of the drag on rear parts of models, through an internal dynamometer and thence to an inflatable membrane, has been obtained at O.N.E.R.A. with a precision better than 0.85%. Author (ESRO)

N69-14800*# General Motors Corp., Indianapolis, Ind. Allison Div.

SINGLE-STAGE EXPERIMENTAL EVALUATION OF BOUNDARY LAYER BLOWING TECHNIQUES FOR HIGH LIFT STATOR BLADES. 4: DATA AND PERFORMANCE OF DOUBLE-SLOTTED 0.75 HUB DIFFUSION FACTOR STATOR

R. H. Carmody and G. Seren Aug. 1968 130 p refs
(Contract NAS3-7619)
(NASA-CR-54567; EDR-5861) Avail: CFSTI CSCL 20D

The test described is part of a program to establish experimentally the extent to which it is feasible to increase compressor stator loading and stall-free flow margin by employing suction surface boundary layer blowing techniques. A secondary objective was to obtain blade element data for design use. Overall and blade element performance of a row of 0.75 hub diffusion factor double slotted stators with self-energized blowing boundary layer control was measured. In addition, the vane static pressure distribution was obtained at three radial locations. Overall and blade element performance was also obtained for the rotor and compared to data previously obtained for this rotor without stator vanes. Preliminary discussion of test results and correlations of data are presented. Author

N69-14820# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

HYPERSONIC FLOW AROUND A SPHERICALLY BLUNTED CONE

Goro Kamimoto and Takeyoschi Kimura Oct. 1967 16 p refs
(CP-19) Avail: CFSTI

In a hypersonic flow, an analysis of the flow around a spherically blunted cone was carried out by applying the equivalence principle. The present experiments were carried out at Mach numbers of 10 by the use of Kyoto University pilot gun tunnel, and the drag and the shock wave shape were measured by the strain gage balance and the Schlieren photographs, respectively. The results of the theoretical analysis was compared with the experimental ones and it was resulted that the drag of the slightly blunted cone is nearly equal to or rather less than the drag of the sharp pointed cone. Author

N69-14828# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

THE TWO-PARAMETER INTEGRAL METHOD FOR UNSTEADY LAMINAR INCOMPRESSIBLE BOUNDARY LAYER OVER A SEMI-INFINITE FLAT PLATE

Goro Kamimoto and Teruaki Akamatsu Oct. 1967 31 p refs
(CP-18) Avail: CFSTI

This paper deals with an unsteady laminar incompressible boundary layer over a semi-infinite plate set in motion impulsively, in order to elucidate an unsteady boundary layer which develops over a flat plate inserted into a shock tube. Expressing the velocity profiles in the boundary layer by polynomials with two unknown parameters (a boundary layer thickness and a form parameter) and dividing the boundary layer into two regions, there are obtained two momentum integrals, which are reduced to simultaneous differential equations. And the solutions making a smooth transition from upstream (Blasius' solution) to downstream (Rayleigh's solution) are obtained. Author

N69-14885# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany). Inst. fur Theoretische Gasdynamik.

ANALYTICAL CALCULATION OF SHOCK WAVES OF ACCELERATED OR DECELERATED AXISYMMETRIC BODIES [ANALYTISCHE BERECHNUNG VON VERDICHTUNGSSTOFEN BESCHLEUNIGTER ODER VERZOGERTER ROTATIONSKORPER]

R. Stuff Oct. 1968 75 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-62; DVL-774) Avail: CFSTI

Characteristic method is modified with respect to the calculation of shock waves from accelerated or decelerated axisymmetric bodies with sharp leading edges. Formulas for the shock wave are obtained for the case that the shock wave detaches from an axisymmetric body decelerating from supersonic to subsonic velocity. Formulas are received for the sonic bangs of the axisymmetric body. These results are valid in distances large compared with the length of the body. It is shown that the damping of shock waves depends more on the acceleration or deceleration as the distance from the body increases and as the velocity approaches the speed of sound. Author

N69-14872*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF UNIT REYNOLDS NUMBER, NOSE BLUNTNESS, ANGLE OF ATTACK, AND ROUGHNESS ON TRANSITION ON A 5° HALF-ANGLE CONE AT MACH 8
P. Calvin Stainback Washington Jan. 1969 78 p refs
(NASA-TN-D-4961) Avail: CFSTI CSCL 01A

A 5° half-angle cone has been tested at a nominal free-stream Mach number of 8 over a range of local, sharp cone unit Reynolds numbers from about 4.5×10^6 per meter (1.3×10^6 per foot) to 4.5×10^7 per meter (1.3×10^7 per foot) in a conventional blowdown tunnel. The nominal ratio of wall temperature to free-stream total temperature was about 0.4. The purpose of the investigation was to determine the effect of unit Reynolds number, nose bluntness, angle of attack, and roughness on the beginning of transition and on laminar and turbulent heating. The results obtained with the smooth models indicated that there was an increase in the transition Reynolds number with increasing unit Reynolds number and a rearward movement of the location of transitions with increasing nose bluntness and angle of attack for the windward ray. Although the hypersonic laminar boundary layer could be tripped with various types of roughness elements, large three-dimensional elements caused circumferential nonuniformities in the heat-transfer distribution around the cone for large distances into the turbulent boundary-layer region. The local transition Reynolds numbers for all bluntnesses (including the sharp tip cone) were correlated reasonably well as a single function of local unit Reynolds number if the local flow quantities were obtained from boundary-layer solutions with variable stream entropy effects included. Also, the agreement between laminar transfer data and theory, in the form of Stanton number as a function of Reynolds number, appeared to be improved if variable-entropy effects were taken into account. Author

N69-14908*# Techtran Corp., Glen Burnie, Md.
DESIGN CONSIDERATIONS IN AIRPLANE WING AERODYNAMICS [ENTWURFSGERECHTE TRAGFLUGEL-AERODYNAMIK]
F. Thomas Washington NASA Jan. 1969 15 p refs Transl. into ENGLISH from a German Report DLR-67-24
(Contract NASw-1695)
(NASA-TT-F-12047; DLR-67-24) Avail: CFSTI CSCL 01C

Aerodynamic design considerations are reviewed for subsonic, transonic, and supersonic aircraft wings; accordingly, the review covers rectangular planforms, arrow wings, and slender delta wings. The overriding considerations are optimization of the lift-drag ratio and the economy of the design with any given weight and thrust. Future trends in wing aerodynamics are also briefly discussed. Author

N69-14911*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
WIND TUNNEL WALL EFFECTS IN V/STOL MODEL TESTING Final Report, 1 Oct. 1965-31 Mar. 1967
G. B. Matthews and William G. S. Hardy Jul. 1968 122 p refs
(Grant NGR-47-005-040)
(NASA-CR-66721; AEEP-4036-102-68U) Avail: CFSTI CSCL 01A

Wind-tunnel wall effects in V/STOL model testing are caused by the large deflection angles of the slipstream from the high-lift propulsion devices in transition from hover to high-speed flight. Accurate representation of the path of the slipstream wake is useful in computing wall effects. The present report is a refinement and verification of Kirkpatrick's method of wind tunnel corrections for V/STOL model testing representing the entrainment of free-stream air and the actual path of the slipstream wake. Results are presented showing effects on the path of revisions in Kirkpatrick's jet analysis and comparisons of the computed path with new data as well as with existing data. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N69-14008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLYING QUALITY FACTORS CURRENTLY LIMITING HELICOPTER NAP OF THE EARTH MANEUVERABILITY AS IDENTIFIED BY FLIGHT INVESTIGATION
Henry L. Kelley, Robert J. Pegg, and Robert A. Champine Washington Dec. 1968 49 p refs
(NASA-TN-D-4931) Avail: CFSTI CSCL 01B

A flight investigation utilizing two modern lightweight helicopters was conducted to study the effects of flying qualities on nap-of-the-earth maneuver capability. Variation in flying qualities was provided by the markedly different stability and control characteristics which resulted from the basically different rotor systems of the two test vehicles. Several tasks were used to provide a realistic basis on which to determine the parameters most pertinent to maneuver capability. The results indicate that the initial angular response characteristics about the roll axis and the sensitivity of the height control are of primary importance. For example, the tightness of the initial roll response, as determined by the magnitude of roll-control sensitivity in combination with angular-velocity damping, had a significant influence on the pilot's ability to attain quickly, precisely, and consequently safely, those bank angles necessary to perform the tasks smoothly. Wind velocity and direction, stick-fixed maneuver stability gradients, angular-velocity and control-system coupling, vibration, and power-governing-system characteristics were other factors that significantly influenced the pilot's ability to maneuver the helicopters. Author

N69-14092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEAR POWERED VTOL AIRCRAFT
William C. Strack and Laurence H. Fishbach Washington 1968 34 p refs
(NASA-TM-X-52524) Avail: CFSTI CSCL 01C

A preliminary design-point study was made of the applicability of nuclear propulsion to very large VTOL aircraft. Fan-in-wing lift engine configurations were analyzed using three different thermodynamic cycles: a helium Brayton cycle, a liquid metal

Rankine cycle with duct heating by the condenser, and a liquid metal Rankine cycle with the condenser in the wing. A gross weight of one million pounds and a design cruise Mach number of 0.8 at an altitude of 36,089 feet were assumed. Variation of gross weight was also considered. Areas of interest in terms of hover time and range requirements were determined that show where nuclear VTOL's appear to be superior to conventional VTOL's. It was found that gross weight is the most significant design parameter affecting the performance of nuclear VTOL aircraft and that the Brayton cycle outperforms the Rankine cycles. Author

N69-14179# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
ON THE FEASIBILITY OF REPLACING A HELICOPTER TAIL ROTOR Technical Report, Jan.–Jul. 1968
A. Sowyrda Jul. 1968 41 p refs
(Contract N00014-68-C-0241)
(AD-677642; CAL-BB-2584-S-1) Avail: CFSTI CSCL 1/3

The feasibility of replacing the tail rotor of a simple helicopter by using fixed aerodynamic surfaces immersed in the rotor wake is examined analytically. Besides furnishing control moments, the major requirements of such surfaces would be to balance the main rotor drive torque. The most challenging flight condition for attaining torque balance is liftoff wherein the rotor torque is high and the dynamic pressure of the wake flow, which provides the energy for the antitorque surfaces, is lowest due to ground effect. Author (TAB)

N69-14225# Collins Radio Co., Cedar Rapids, Iowa.
COMPUTER/SIMULATION STUDY OF AIR-DERIVED SEPARATION ASSURANCE SYSTEMS IN MULTIPLE AIRCRAFT ENVIRONMENT Interim Report
John Holt, Lee Belden, and William Jameson Jul. 1968 182 p
(Contract FA-WA-4598)
(RD-68-34) Avail: Issuing Activity

The three subject areas treated in this report are hazard evaluation in maneuvering environments, air-to-air oscillator synchronization, and minimum systems for general aviation. Hazard evaluation is analysed in both the horizontal and vertical dimensions. Some of the analysis presumes that the air-derived separation assurance system (ADSAS) is of the time-frequency type. Most of the principles discussed are equally applicable to other forms of ADSAS, however the discussion of air-to-air synchronization is specifically devoted to the time-frequency type. Author

N69-14504*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A MATHEMATICAL MODEL FOR CALCULATING THE FLIGHT DYNAMICS OF A GENERAL PARACHUTE-PAYLOAD SYSTEM
Joe D. Gamble Washington Dec. 1968 34 p refs
(NASA-TN-D-4859) Avail: CFSTI CSCL 01A

An analysis yielding six-degree-of-freedom equations of motion is presented for predicting the dynamic behavior of a general parachute-payload system. The parachute canopy and associated air-mass are approximated as a rigid body, and separate equations of motion are derived for the canopy and payload subject to the constraint of the risers and suspension lines. The analysis determines the forces and the response of various riser and suspension-line geometries subjected to large displacements, under the assumption that these lines are linearly elastic. The equations are readily adaptable to computer solutions and should be of interest in analyzing the dynamic performance of lifting-parachute payload systems. Author

N69-14678*# General Dynamics /Fort Worth, Tex.
PARAMETRIC STUDY OF B-58 ACCELERATION RESPONSE TO TURBULENCE AND COMPARISONS WITH FLIGHT DATA, AUGUST 1967–AUGUST 1968
R. P. Peloubet, Jr. and R. L. Heller Nov. 1968 211 p refs
(Contract NAS1-7491)
(NASA-CR-66699) Avail: CFSTI CSCL 01B

The results of an investigation to compare gust response acceleration transfer functions computed by analysis to those measured during a B-58 flight test program are presented. The manner in which the B-58 data were measured and reduced to power spectral density and transfer function form is described. The degree of correlation between computed and measured B-58 natural frequencies and mode shapes is shown. Acceleration transfer functions computed for flight conditions which matched the flight conditions that existed during selected flight test gust runs are compared with the measured transfer functions. The results of analyses which were repeated for small variations in parameters employed in the calculation of the transfer functions are presented to show their separate effects. The effects of two-dimensional turbulence and spectral averaging are presented. Author

N69-14719# Library of Congress, Washington, D. C. Aerospace Technology Div.
AIRCRAFT MECHANICAL SUBSYSTEMS
A. Dolgich Oct. 1968 138 p refs
(AD-677056; ATD-68-43-22-4) Avail: Issuing Activity CSCL 1/3

This report consists of an analytical survey of information and abstracts presented in six sections as follows: Flight Control Subsystems (Sec. A); Hydraulic and Pneumatic Subsystems (Sec. B); Anti-Icing Subsystems (Sec. C); Cabin Pressurization, Cabin Thermal Control, and Oxygen Subsystems (Sec. D); Electrical and Fuel Subsystems (Sec. E); and Fire Extinguishing, Emergency Escape, Landing Subsystems, and Stands for Testing Aircraft Instruments (Sec. F). Author (TAB)

N69-14729*# Litchford Systems, Northport, N. Y.
STUDY OF ADVANCED ELECTRONIC APPLICATIONS TO AERONAUTICAL DISPLAY AND CONTROL PROBLEMS
G. B. Litchford Washington NASA Jan. 1969 140 p refs
(Contract NASw-1541)
(NASA-CR-1240) Avail: CFSTI CSCL 01D

Electronic aids for navigation, ATC, and collision avoidance in the field of general aviation are discussed, with the aim of accomodating the pilot with minimum IFR capability. Low cost electronic air and ground aids are outlined, and time shared VHF Omnirange (VOR) area coverage is evaluated. Data transmission techniques are discussed as to potential, cost, and effectiveness. General aviation use of the national Secondary Surveillance Radar System (SSR) is treated in light of increased air traffic, both commericial airline and general aviation, in altitudes less than 10,000 feet and the corresponding increase in collision potential. Recent developments in the SSR system include a low cost modified airborne transponder which could be installed in general aviation aircraft to effectivaly combat the risk of collision in dense airspace. Electronic simulation of very low visibility landing guidance and instrument displays is discussed as to presently available equipment and the need for more flexible and complex systems. A summary of the general requirements of computer generated low visibility landing systems concludes the study. A.C.R.

N69-14763*# Stencel Aero Engineering Corp., Asheville, N. C.
HUMAN SURVIVAL IN AIRCRAFT EMERGENCIES
Charles A. Yost and Ronald W. Oates Washington NASA Jan. 1969 61 p refs
(Contract NASw-1530)
(NASA-CR-1262) Avail: CFSTI CSCL 01B

A general study was performed to outline methods for the improvement of human survival in civilian aircraft emergencies. Survival condition criteria, accident statistics and human tolerance limits were surveyed with respect to those aircraft used in two categories: certificated air carriers and general-private aviation (including official executive aircraft). The methods presented for aircraft occupant survival improvement fall into the general areas of occupant protection through seat design and occupant restraint improvement to withstand impact accelerations which are applied to the aircraft. Author

N69-14831# Royal Aircraft Establishment, Farnborough (England).
A VERSATILE TEST UNIT FOR FORCE FEEDBACK ACCELEROMETERS
D. J. Miles May 1968 28 p refs
(RAE-TR-68125) Avail: CFSTI

A laboratory unit is described designed to test a wide range of force feedback accelerometers which are used in inertial navigation. Basic circuits are given together with open and closed loop servo responses for accelerometers with and without viscous damping. The effects of variation in the test unit parameters are analyzed and shown to have virtually no effect on accelerometer performance data obtained. Author (ESRO)

N69-14847# Royal Aircraft Establishment, Farnborough (England).
WARNING MONITORS FOR AUTOMATIC LANDING: A FEASIBILITY STUDY
B. D. Armstrong, K. F. Goddard, and J. C. Penwill Apr. 1968 46 p refs
(RAE-TR-68094) Avail: CFSTI

An extensive computer study has been done to see if there is any possibility of developing an all-embracing monitor capable of warning pilots in advance that their landing will not be successful, in the unlikely event of interference with an automatic landing in Category III conditions ('interference' being used in the broadest sense). It is concluded that such a monitor is not feasible, and mistaken attempts to provide it could in certain circumstances increase the system risk. Author (ESRO)

N69-14932# National Aerospace Lab., Tokyo (Japan). V/STOL Aircraft Div.
SYSTEMS DESIGN OF FLYING TEST BED FOR VTOL AIRCRAFT AT NATIONAL AEROSPACE LABORATORY
1968 84 p refs In JAPANESE; ENGLISH summary
(NAL-TR-154) Avail: CFSTI

To investigate problems associated with hovering, vertical take-off and landing of VTOL aircraft, a FTB (Flying Test Bed) was developed. This report is concerned with the system design and the general description of the FTB. The FTB consists of the following components: a tubular framework body with three landing gears, two JR-100F turbojet engines for the lift-generating prime mover and also for the bleed-air source, four air-jet nozzles for attitude control, automatic stabilization equipment for height and attitude control, an air turbine unit for auxiliary power source, and many functional back-up systems for improvement of the overall system reliability. Expected gains that will be obtained through the development of the FTB are as follows: (1) to provide the basic data for the design of VTOL aircraft; (2) to ascertain the problems and their countermeasures involved in VTOL aircraft technologies, and ultimately; (3) to enlarge the possibilities for domestic development of VTOL aircraft. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N69-13044*# Battelle Memorial Inst., Columbus, Ohio.
AN ADVANCED THERMOELECTRIC LIFE TEST AND EVALUATION STUDY Final Report, 28 Dec. 1967-28 Sep. 1968
28 Sep. 1968 208 p refs
(Contract NAS5-10497)
(NASA-CR-98628) Avail: CFSTI CSCL 10B

A comprehensive study was made of the theory of the measurement of Seebeck coefficient, electrical resistivity, and electrical contact resistivity. On the basis of these studies, test apparatus was designed and measurements were performed in order to optimize procedures and empirically derive the precision limits associated with the technique. The user orientation of input-output formats of the existing RTG computer program was completed. The mathematical model used in the analysis was qualified by performing a three dimensional heat transfer analysis of a typical generator design case. Theoretical thermopile performance data were incorporated into a typical RTG design in order to predict the output power and efficiency of the system as a function of time. The Seebeck coefficient, electrical resistivity, and thermal conductivity were measured for 2p-PbTe and 3p-PbSnTe materials in nonstandard conditions. Author

N69-14101# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
TRANSISTORIZED DIRECT CURRENT MOTOR CONTROL
Warren R. Sheets 10 Sep. 1968 6 p
(Contract AT(29-1)-1106)
(RFP-1000) Avail: CFSTI

A transistorized direct current motor control is described. The control has been installed on an electric platform-lift truck to permit continuous speed adjustment of both the hoist and travel motors. The control is designed to supply a maximum of 360 amperes from a 12-volt battery to load consisting of a direct current motor and current-limiting resistor. To adjust the speed of the two motors, potentiometers are used. The control circuit efficiency was found to exceed 80 percent. Author (NSA)

N69-14951*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT OF A CHEMICAL HEATER FOR A MARS ROUGH-LANDING CAPSULE
M. B. Gram 15 Dec. 1968 17 p
(Contract NAS7-100)
(NASA-CR-98658; JPL-TR-32-1343) Avail: CFSTI CSCL 13A

Preliminary work has been performed on one version of a chemical heater, sized to provide one night of survivability for a Mars rough lander. The effects of the impact environment and heat sterilization requirement on the design are discussed. The resulting chemical heater utilizes chlorine trifluoride and boron reactants, weighs 3 lb, and has a heat yield of 1940 Wh. Author

N69-14223*# Techtran Corp., Glen Burnie, Md.
DETERMINATION OF THE PARAMETERS OF THE SELF-OSCILLATION PROCESS IN A STEAM-GENERATING CONDUIT [OPREDELENIYE PARAMETROV AVTOKOLEBATEL'NOGO PROTSESSA V PAROGENERIRUYUSHCHEM KANALE]

K. N. Proskuryakov Washington NASA Dec. 1968 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii Energ. (Minsk), no. 10, 1965 p 92–96
(Contract NASw-1695)
(NASA-TT-F-12127) Avail: CFSTI CSCL 13K

The conditions of self oscillation in a steam generating system equipped with an economizer and vaporizer are investigated for the case two phase flow. The relations employed for expressing these conditions are described. It has been established that the periodic parametric pulsations occurring in steam generating conduits under certain conditions are self oscillations, and that a high amplitude of pulsation in the heat flux on the steam-generating surface of the heat exchanges corresponds to a large magnitude of the parameter characterizing the damping of oscillations in a two phase flow. Author

N69-14299*# General Electric Co., Schenectady, N. Y. Physical Chemistry Lab.
LOW-TEMPERATURE BALLOON BATTERY Final Report, 29 May–29 Sep. 1968
W. N. Carson, Jr. and J. F. Wilfore 30 Sep. 1968 48 p
(Contract NAS5-11556)
(NASA-CR-98666; S-68-1177) Avail: CFSTI CSCL 10C

This program was directed towards determining the suitability of four galvanic cell systems (mercuric oxide-cadmium, silver chloride-cadmium, silver chloride-zinc, and silver-iodine with solid state electrolyte) as the basis for the design of a low-temperature, rechargeable balloon battery. Experimental studies on the four cell systems showed that all four systems gave fair to good discharge performance at −60°C; all can be recharged at −60°C and −30° with high efficiency. However, none of the systems can meet the weight specification of 700 grams if the remaining specifications are to be met as well. The best system, in terms of minimum total weight needed and performance at low temperatures, is the mercuric oxide-cadmium system with 60 percent cesium hydroxide electrolyte. This cell system was the one selected for further study. Author

N69-14312*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALOG SIMULATION OF CLOSED LOOP BRAYTON CYCLE TEST FACILITY
Hugh Klassen Washington Dec. 1968 29 p refs
(NASA-TM-X-1715) Avail: CFSTI CSCL 14B

The performance of a Brayton cycle test loop, which contained an experimental turbocompressor, was simulated with an analog computer. The working fluid was argon. The results of actual and simulated test runs were compared. The variation of rotative speed with time during injection starts is shown as a function of injection rate, turbine inlet temperature, and loop volume. The operating characteristics of the compressor are shown during injection starts. Author

N69-14328# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
RADIAL VANE STEAM SEPARATOR DEVELOPMENT, PHASE 2 Final Report
R. H. Moen Jul. 1968 27 p refs
(Contract AT(04-3)-189)
(GEAP-5655; EURAEC-2060) Avail: CFSTI

The design of a radial vane steam separator and related work was carried out as Phase II of the Radial Vane Steam Separator Development Program. This involved testing of a larger model separator, design of the separator and related studied, planning, instrumentation design, and model vibration studies. The program was terminated prior to completion because agreement on financial terms for a test in a boiling water reactor could not be reached. The results of the part of the program which was completed are summarized. The use of a radial vane steam separator still appears to be feasible, but a test of a reactor-size separator is required to prove this. Author (NSA)

N69-14371*# Pennsylvania Research Associates, Inc., Philadelphia.
ADVANCED FUEL CELL CATALYSTS Status Report, 10 Aug.–10 Nov. 1968
10 Nov. 1968 16 p
(Contract NAS7-574)
(NASA-CR-98668; EC-SR-6) Avail: CFSTI CSCL 10B

The production status of advanced fuel cell catalysts is presented. Crystal boules of AuCu, Al doped, were pulverized in an automatic mortar and pestle to accumulate 5 μ particle size material. An inert gas jet was considered for use to produce uniform particles of 0.1 μ. Electrodes were fabricated by spraying a suspension of the AuCu powder on a Ni screen. The catalytic activity of chunks of coarsely polycrystalline materials in half cells was measured and found to be two to three times better than Pt in the areas below 0.5 mA. In higher current areas the current to voltage ratio increases very considerably in favor of the AuCu catalyst. The Ni electrode sprayed with a suspension of 1 μ brittle AuCu was tested in a 5NKOH solution at 1 Atm oxygen and hydrogen pressure and at 75°C. Results were 0.8 V for 250 mA/cm^2. B.P.

N69-14397*# American Cyanamid Co., Stamford, Conn. Research Labs.
HIGH-PERFORMANCE LIGHT-WEIGHT ELECTRODES FOR HYDROGEN-OXYGEN FUEL CELLS
D. Gershberg, W. P. Colman, K. E. Olson, and E. W. Schmitz Washington NASA Dec. 1968 188 p refs
(Contract NAS3-8524)
(NASA-CR-1216) Avail: CFSTI CSCL 10B

This report covers work done with electrodes in alkaline, matrix-type fuel cells operating on hydrogen and oxygen. The principal objective was to determine and recommend preferred matrix materials and operating conditions under which these electrodes would be capable of 2000-hour performance in a total module having a weight to-power ratio substantially lower than those presently available for space environment. The experimental program included evaluation of potentially suitable matrix materials and life testing in small and in battery-size cells. Author

N69-14430# Siemens-Schuckertwerke A. G., Erlangen (West Germany).
DEVELOPMENT OF EMITTERS AND COLLECTOR MULTI LAYER SYSTEMS [ENTWICKLUNG VON EMITTERN UND KOLLEKTORMEHRSCHICHTSYSTEMEN]
H. Hubner, K. Janner, and M. Peehs Aug. 1968 118 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-57) Avail: CFSTI

The described work is a part of an in-core-thermionic-reactor development program. The system is proposed as an energy source for space vehicles. The thermionic element is built up of 8 cells in series. UO_2 pellets will be used as fuel. The fission gas of each emitter is vented separately to omit swelling due to fission gas pressure at the designed fuel burn up. Adequate methods to prevent plugging of the venting system were investigated. An instrumented capsule for in-pile testing emitters at nominal and higher heat rating was designed and is now under construction. Tungsten layers were deposited from the $W(CO)_6$. The interfacial diffusion of Mo-W was investigated. The joining technology for the designed element was developed. A method to build concentric collector systems ($Nb-Al_2-O_3-Nb/1Zr$) was proved with good success. Author

N69-14518*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF THE DYNAMICS OF WATER REJECTION FROM A MATRIX TYPE OF HYDROGEN-OXYGEN FUEL CELL
Paul R. Prokopius and Robert W. Easter Washington Dec. 1968 24 p refs
(NASA-TN-D-4956) Avail: CFSTI CSCL 10B

An experimental study of water-rejection dynamics was conducted on a matrix type of hydrogen-oxygen fuel cell which employs a hydrogen stream to extract the product water. Step transients were introduced in the hydrogen inlet humidity and in the rate of electrochemical water production. The resulting water-rejection transients were measured as changes in hydrogen outlet humidity. The transient response data were compared to the responses of a mathematical model developed for a Bacon type of cell. Data are presented which illustrate the effects that various initial operating conditions have on the outlet humidity responses for step transients in both inlet humidity and the rate of water production. Author

N69-14529*# Naval Research Lab., Washington, D. C.
THE PLATE MATERIALS OF THE LEAD-ACID CELL. PART 4: ANODIC OXIDATION OF THREE REPRESENTATIVE OXIDES Final Report
Jeanne Burbank Sep. 1968 18 p refs
(AD-677033; NRL-6768) Avail: CFSTI CSCL 10/3

Three representative lead oxides, designated A, C, and H, for storage-battery fabrication were mixed with water and H_2SO_4 to paste consistency. Each of these was hand pasted into antimonial and pure-lead circular grids of standard SLI thickness. The plates were cured according to common practice for each oxide. The small circular plates were anodized in an electrolytic cell mounted directly on an x-ray machine, and the diffraction patterns were recorded at intervals throughout 72 hr of formation in 1.0585 sp gr H_2SO_4. X-ray diffraction patterns from the unformed pastes showed the major component was tribasic lead sulfate in all three. The surfaces of plates made from oxides A and H were primarily basic lead carbonate (hydrocerussite), and the surfaces of plates made with oxide C were largely tribasic lead sulfate. On completion of anodization, nominally 150% of the theoretical requirement on a weight basis, the pastes were blotted and dried in air at room temperature. The formed paste was removed from the grids for electron-microscope examination by carbon replication. The PbO_2 had a range of morphologies, and the individual crystallites varied from about 0.5 microns to less then 0.1 microns. Some prismatic crystals with branching suggestive of multiple twinning were present in past A and appeared less frequently in the other two pastes. Agglomerates, several microns in size, of prismatic crystallites were present in all pastes. Paste H gave rise to the largest individual crystallites which were about 0.5 microns in diameter. Author (TAB)

N69-14594 Yeshiva Univ., New York.
ANALYSIS OF AN ULTRAFAST DISCHARGE IN AIR PRODUCED BY A MEGAVOLT PULSE SYSTEM
Joshua Shuchatowitz (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-5576

An alternative to the Marx circuit for the production of high-voltage, high-current pulses has been developed. It employs a water immersed spiral-wound step up transformer capable of obtaining an output of one million volts from a capacitor bank charged to 100 kilovolts. A method is derived for using this transformer to efficiently pulse-charge a second capacitor bank without very tight coupling. The primary and secondary circuits each contain two resonant frequencies (each measured with the other circuit open). It is shown that total transfer of energy (except for dissipation) occurs when the two resonant frequencies of the primary and secondary are equal. The two normal mode frequencies of the coupled circuit should be in the ratio of 2:1 employing a coupling coefficient of 3/5. The design and application of such a system to produce a discharge in air at atmospheric pressure is described ($E = 10^4$ Joules, V-720 kV). Dissert. Abstr.

N69-14636*# Atomic Energy Establishment, Winfrith (England).
IDENTIFICATION AND OPTIMIZATION STUDIES OF THE DYNAMICS OF A SMALL EXPERIMENTAL BOILER
J. D. Cummins Oct. 1967 175 p refs
(AEEW-R-580) Avail: CFSTI

A small experimental boiler was constructed and identification and optimization studies of the dynamic characteristics made. Steady state and transient measurements were made and a mathematical model of the dynamics of the system developed and compared against experimentally determined dynamic responses. The latter are derived by perturbing the heat input and continuous loop mass flow with a suitable pseudo-random binary chain code, and by then calculating on the line the cross-correlation functions between responses—temperatures, water level and mass flows, and the perturbing signals. Equivalent impulse responses are determined in a digital simulation of the mathematical model. The model is then adjusted to give agreement with the experimental responses. This adjustment is performed by an optimization scheme based on the minimum mean square deviation of the two sets of system transient responses. Author (NSA)

N69-14677*# Whittaker Corp., San Diego, Calif. Research and Development/San Diego.
ELECTROCHEMICAL CHARACTERIZATION OF NONAQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION Quarterly Report, May—Jul. 1968
M. Shaw, O. A. Paez, and D. A. Lufkin 16 Aug. 1968 48 p ref
(Contract NAS3-8509)
(NASA-CR-72482; QR-8) Avail: CFSTI CSCL 10C

The electrochemical characterization of 950 nonaqueous battery systems, with regard to secondary battery application, resulted in a list of twenty-four recommended positive electrolyte systems. Additional evaluation of these twenty-four systems included wet stand compatibility tests and solubility measurements of charged state material on wire electrodes. A program, using sintered type electrodes, to measure discharge capacity as a function of charge inputs for the recommended systems was initiated. The results on nineteen systems are presented. Author

N69-14715*# Eagle-Picher Co., Joplin, Mo.
HEAT-STERILIZABLE, REMOTELY ACTIVATED BATTERY DEVELOPMENT PROGRAM, PHASE I Quarterly Report, 1 Jul.–30 Sep. 1968
25 Oct. 1968 16 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-98719; QR-1) Avail: CFSTI CSCL 10C

An investigation is underway of basic cell and battery components and materials to characterize individual capabilities to withstand the heat sterilization routine and retain desirable properties. Testing of absorbent type plate separation materials of common variety revealed that cellulosics, asbestos and pure nylon were least affected by the dry sterilization routine. Polypropylene types of separation material were physically changed causing structure breakdown. Preliminary results indicate that sterilization does not appreciably alter the wetting and retention characteristics of the surviving materials. A preliminary survey of possible propellents which would be capable of heat sterilization without degradation of properties was conducted. The results show that three types of propellants may be applicable: magnesium-silicon

perchlorate, ammonium picrate, and ammonium perchlorate formulations. One informal test was conducted with a reverse bend electrolyte reservoir. The reservoir was heat sterilized with no degrading effects ascertained. Author

N69-14759*# McDonnell-Douglas Co., Huntington Beach, Calif. Western Div.
PARAMETRIC STUDY OF SPACE POWER SYSTEMS. VOLUME 1: SUMMARY Final Report
A. D. Tonelli Nov. 1968 30 p
(Contract NAS2-4482)
(NASA-CR-73279; DAC-62303-Vol-1) Avail: CFSTI CSCL 22B

Presented is a summary of the study methodology and significant results of the Parametric Study of Space Power Systems. Included in this report is a description of the study objectives and methodology; a listing of the power subsystems, systems and mission constraints that were investigated; a description of the developed H-521 computer program indicating the flow network, examples of input and output data, and sensitivity analysis performed on a typical space power system using the H-521 program. Also included in the report are recommendations of future work to increase the versatility and capability of the computer program. Author

N69-14760*# McDonnell-Douglas Co., Huntington Beach, Calif. Western Div.
PARAMETRIC STUDY OF SPACE POWER SYSTEMS. VOLUME 2: TECHNICAL REPORT Final Report
A. D. Tonelli Nov. 1968 302 p refs
(Contract NAS2-4482)
(NASA-CR-73280; DAC-62304-Vol-2) Avail: CFSTI CSCL 22B

Presented are the results of the study effort on the Parametric Study of Space Power Systems. Included in the report is a description of the rationale used to select the power systems for investigation, a description of the guidelines and constraints used in the study, a description of the methodology used in the analysis of the power systems, and a review of complete power systems characteristics and sensitivity analysis. Also presented is a description of the H-521 computer program developed in the study, and a summary of power system technology readiness. Author

N69-14761*# McDonnell-Douglas Co., Huntington Beach, Calif. Western Div.
PARAMETRIC STUDY OF SPACE POWER SYSTEMS. VOLUME 3: POWER SUBSYSTEM PARAMETRIC DATA Final Report
A. D. Tonelli Nov. 1968 328 p refs
(Contract NAS2-4482)
(NASA-CR-73281; DAC-62305-Vol-3) Avail: CFSTI CSCL 22B

This volume presents the parametric data that were used in performing the Parametric Study of Space Power Systems. The information includes parametric data on power conversion subsystems, energy sources, heat rejection subsystems, power conditioning subsystems, energy storage, power distribution subsystems, and integration of the power system with the space vehicle. The parametric data are the baseline or reference data that were used in calculating the characteristics such as mass, volume, area, cost, and reliability of the various power systems, subsystems, and major components. Author

N69-14771*# Monsanto Research Corp., Boston, Mass.
RESEARCH AND DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Final Report, 1 Jul. 1967–30 Jun. 1968
John S. Driscoll and David L. Williams 1 Sep. 1968 73 p refs
(Contract NAS3-9431)
(NASA-CR-72464; MRB5014F) Avail: CFSTI CSCL 10C

Laboratory work on the dry tape battery concept showed that the Li/$LiClO_4$-methyl formate/DCA-70 system would produce energy densities in excess of 200 watt-hr/lb, based on anode, cathode, separater, and electrolyte weights. The program was designed to increase the cathode efficiency and current density of this cell while retaining the high energy density previously demonstrated. The high current densities are necessary for advantageous use of the Dry Tape concept. Author

N69-14806*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NICKEL POWDERS AND PLAQUES FOR NICKEL-CADMIUM CELL PLATES
Gerald Halpert Oct. 1968 16 p ref
(NASA-TM-X-63425; X-735-68-400) Avail: CFSTI CSCL 10C

Nickel powders and plaques are being investigated in an effort to develop more uniform and predictable battery-plate materials for nickel-cadmium aerospace cells. Two aspects of this effort are described herein: the development of uniform materials, and the characterization and effect of changes in the materials during operation. Average particle sizes of the nickel powders used in the manufacturing of plaques are determined by using the Fisher sub-sieve sizing method and by use of the scanning electron microscope. Photographs of the nickel powders and plaques are described. Author

N69-14917*# Texas Instruments, Inc., Dallas.
LITHIUM-DIFFUSED SOLAR CELLS Quarterly Report, 1 Jul.–30 Sep. 1968
Don L. Kendall and Raymond A. Vineyard Oct. 1968 20 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952248)
(NASA-CR-98718; REPT-03-68-84; QR-2) Avail: CFSTI CSCL 10B

Lithium is generally observed, in silicon as an interstitial doner. However, lithium substitutional acceptors have been identified and their concentrations measured. Heavily boron-doped silicon (5×10^{19} cm^{-3}) has been compensated by lithium and the resultant resistivity (apparent) determined as a function of time. Solar cells were fabricated from Lopex* and float-zoned silicon by the standard evaporated Li source technique followed by a 400°C diffusion for 90 minutes on each group. Author

N69-14918*# TRW Systems, Redondo Beach, Calif.
STUDY OF RADIATION EFFECTS IN LI-DOPED SILICON SOLAR CELLS Quarterly Report, Aug.–Oct. 1968
R. G. Downing, J. R. Carter, and W. K. Van Atta 15 Nov. 1968 41 p Prepared for JPL
(Contracts NAS7-100; JPL-952251)
(NASA-CR-98713; TRW-10971-6008-R0-00; QR-2) Avail: CFSTI CSCL 10B

Studies of the annealing of irradiated lithium doped crucible silicon solar cells indicate considerable improvement over previous devices with annealing times of the order of 10 days at room temperature. Considerable divergence is evident in the data indicating strong response dependence on subtle manufacturing techniques or material characteristics which are not normally identified. A group of float zone lithium doped solar cells were studied as a function of redistribution time at 250°C. The lithium concentration at the junction is observed to rise rapidly until a maximum is reached after which further redistribution reduces the lithium concentration to an undetectable value. Short circuit current is reduced as the lithium concentration near the junction reaches a maximum value. The short circuit current remains constant thereafter even though the lithium is being depleted from the junction region. Carrier removal studies indicate a deep lying acceptor defect which may be responsible for observations of incomplete annealing of lithium doped cells. Author

N69-14819*# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
ACTION OF LITHIUM IN RADIATION-HARDENED SILICON SOLAR CELLS Quarterly Report, 16 Jul.–15 Oct. 1968
G. J. Brucker, T. J. Feith, and A. G. Holmes-Siedle 15 Nov. 1968 81 p refs
(Contracts NAS7-100; JPL-952249)
(NASA-CR-98717; AED-R-3389; QR-2) Avail: CFSTI CSCL 10B

Continuing tests on cells irradiated to fluences from 10^{14} to 10^{16}e/cm^2 indicate that to obtain good long-term stability in cells made from silicon of low oxygen content, lithium density should be made as low as is compatible with maximum cell recovery for the fluence applied to the cells. Pre-irradiation measurements made on quartz crucible cells showed that those with low-lithium-density gradient had tungsten efficiencies with an average of 10.9 percent; a second group with high-lithium gradient had tungsten efficiencies with an average of 7.5 percent. Preliminary measurements on float-zone cells indicate that the lithium diffusion constant in these cells increases with increasing distance from the junction. Hall-coefficient and resistivity measurements were used to investigate the crystal growth and irradiation-temperature dependence of the introduction rate and room-temperature annealing of carrier-removal defects in lithium-doped silicon. Carrier densities measured at or near-room temperature decreased in quartz crucible silicon and increased in float-zone silicon. Crucible-silicon samples annealed to 373°K for 10 minutes exhibited complete recovery of mobility. Complete recovery of mobility in Float-Zone silicon took place in an annealing time ≤ 17 hours at room temperature.
Author

N69-14820*# Thermo Electron Engineering Corp., Waltham, Mass.
SIX-CONVERTER SOLAR THERMIONIC GENERATOR Final Report, 10 Jan. 1967–31 Mar. 1968
T. Athanis, P. Shefsiek, and L. Lazaridis Jun. 1968 110 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951770)
(NASA-CR-98712; TE4073-146-68) Avail: CFSTI CSCL 10B

A six-converter solar thermionic generator was designed, fabricated and subjected to preliminary evaluation. Six additional thermionic converters similar to those used in the generator were fabricated and individually tested. With the exception of one, each of the twelve converters produced more than 38 watts of output power at 0.7 volt output voltage, and at 2000°K emitter temperature. The average power output per converter was 37.5 watts. All converters have identical overall configuration, employing planar electrode geometry with a rhenium emitter (of about 2 cm^2 area), and a molybdenum collector separated by about 0.005 cm (2 mils) during operation. Critical parts of each converter and of the generator in general were subjected to detailed design analysis and performance evaluation. Heat flux distribution and temperature profiles, heat transfer mechanisms, and heat dissipation requirements in the generator were determined.
Author

N69-14821# Aerospace Corp., El Segundo, Calif. Lab. Operations.
NEUTRON DAMAGE TO SILICON SOLAR CELLS, JUNE 1967–JANUARY 1968
Edwin J. Stofel, Thomas B. Stewart, and Joseph R. Ornelas Jun. 1968 51 p refs
(Contract F04695-67-C-0158)
(AD-676976; TR-0158(3250-20)-5; SAMSO-TR-68-388) Avail: CFSTI CSCL 10/2

Silicon solar cells of the n/p 5 to 10 ohm-cm type were irradiated with neutron fluences from 5.2 x 10 to the ninth power to 1.5 x 10 to the 13th power n/sq cm) using a TRIGA reactor. Current-voltage characteristics, spectral response, and diffusion length measurements were made and the results interrelated. Agreement with theory is good. Diffusion length depends upon injection level in a manner similar to that for proton irradiation.
Author (TAB)

N69-14868*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
SOLAR CELL RADIATION FLIGHT EXPERIMENT Quarterly Progress Report, 14 Aug.–2 Dec. 1968
W. P. Dawson 16 Dec. 1968 60 p Prepared for JPL
(Contracts NAS7-100; JPL-952361)
(NASA-CR-98715; SSD-80512R; QPR-1) Avail: CFSTI CSCL 10B

The detailed design of the Solar Cell Radiation Flight Experiment, scheduled for launch on the ATS-E spacecraft, Project Status and results of tests conducted to date are presented.
Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N69-13932# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
INTERPRETING COUNTING DATA FOR INTERNALLY DEPOSITED PLUTONIUM
K. L. Swinth *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 1–14 refs Reprinted (See N69-13931 04-14)
Avail: CFSTI

Developmental, sensitive counters presage enhanced measurement of internally deposited plutonium by counting the low-energy photons emitted by the plutonium. General factors influencing the interpretation of counting data include: (1) The change in photon emission rate with variable isotopic composition; (2) The low penetrating power of the radiations; and (3) The variable background due to high-energy radiations of other isotopes. This paper discusses methods of correcting for such effects. Background variations become critical for low-level counting and data show that differences in low-energy (~17 keV) backgrounds of greater than a factor of two can be expected and are caused primarily by the contribution from other internal radionuclides. As described, such information can be correlated with count rates in other energy regions. Finally, the paper discusses the role of pulmonary clearance effects as related to counting.
Author (NSA)

N69-13938# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
DEVELOPMENT IN THE TIDAL VOLUME AIR MEASUREMENT
R. L. Wilbur *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 38–41 refs (See N69-13931 04-14)
Avail: CFSTI

Studies of deposition of inhaled radionuclides in animals require an accounting of the amount of air respired. An earlier instrument merely counted the breaths and measured the inhalation volume. Modifications to the basic instrument enable the digital portion of the device to accept many different transducers and to examine either the inhalation or the exhalation portion of the respiration cycle. Two remote operating stations increase the mobility and versatility of the instrument. Several internal circuit changes provide greater breath monitoring latitude, smoother printer operation, and greater operator safety.
Author (NSA)

N69-13938# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

DEVELOPMENTAL EVALUATION OF MINIATURE BIOLOGICAL SENSING TRANSDUCERS

R. L. Wilbur *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 44–48 (See N69-13931 04-14)

Avail: CFSTI

Physiological and pathological studies being conducted at PNL require many different forms of bioinstrumentation. Present commercial transducers often fail during experiments or may not be acceptable for one or more physical and environmental reasons. An evaluation record of the performance of transducers used in past, current or future experiments should alleviate these difficulties, save money and time and provide accurate physiological data quickly. The program also provides selective information regarding transducers and aids in planning application methods appropriate to the acquisition of data in a manner that insures an acceptable attrition rate for the transducers. This report describes the information acquired to date on the characteristics, preparation, calibration, and operation of four selected implantable transducers.

Author (NSA)

N69-13939# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

SURFACE TENSION INSTRUMENT

R. L. Wilbur *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 49–53 refs (See N69-13931 04-14)

Avail: CFSTI

Material of marked surface activity has been obtained from the pulmonary alveoli of mammals. Experimental results indicate a hysterisis at the air–liquid interface of lung tissue which varies with the surface tension. This report describes an instrument that measures these effects *in vitro* in a manner closely analogous to the *in vivo* situation. It also discusses the instrument used, the derivation of the surface tension equation, and the operation of the instrument, with emphasis on the acquisition of accurate surface tension measurements.

Author (NSA)

N69-13948*# Midwest Research Inst., Kansas City, Mo.

BIOMEDICAL APPLICATIONS OF AEROSPACE-GENERATED TECHNOLOGY Quarterly Report, 1 Sep.–30 Nov. 1968

David Bendersky and Wilbur E. Goll 13 Dec. 1968 38 p refs

(Contract NSR-26-002-083; MRI Proj. 3217-E(A))

(NASA-CR-98604; QR-2) Avail: CFSTI CSCL 06

Activities of the Biomedical Applications Team at Midwest Research Institute on 30 problems submitted by the participating medical institutions are discussed. It is reported that potential solutions were found to 20 of these problems. Four transfers of technology were completed, which include X-ray photograph enhancement, a system for delivery of medication to the respiratory tract, temperature telemetry for internal organs, and an enzyme amplifier and telemetry system.

Author

N69-13956 Vanderbilt Univ., Nashville, Tenn.

THE CRYSTAL STRUCTURE OF CALCIUM 1, 3-DIPHOSPHORYLIMIDAZOLE

Leon Neely Beard, Jr. (Ph.D. Thesis) 1967 84 p

Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-5381

The crystal structure of calcium 1, 3-diphosphorylimidazole, $Ca_3[C_3N_2H_3(PO_3)_2]_2 \cdot 12H_2O$, has been determined by X-ray diffraction methods. The compound is of interest in the study of phosphate transfer in biological processes. The crystals are triclinic, space group P1, with $a = 8.91$, $b = 11.29$, $c = 9.92$ Å, $\alpha = 102.44°$, $\beta = 92.31°$, $\gamma = 106.47°$, $Z = 2$. Visual estimations of 2020 intensities on levels of 0kl–8kl were made from Weissenberg photographs; 323 reflections on levels 7kl–10kl were measured with a diffractometer using the 2θ-scan technique. Mo$K\alpha$ radiation was used with both techniques. The phosphorus and calcium atoms were located from a Patterson synthesis. The remaining atoms, including all fifteen hydrogen atoms, were located from difference syntheses.

Dissert. Abstr.

N69-14127# Brookhaven National Lab., Upton, N. Y. Medical Research Center.

USE OF Cf 252 AS AN INTERSTITIAL SOURCE OF FAST NEUTRONS

Harold L. Atkins [1967] 18 p refs Presented at Meeting of the Transplutonium Program Comm., Germantown, Md.

(BNL-12409; CONF-680420-1) Avail: CFSTI

Unlike γ rays and X-rays, the biological action of neutrons is virtually independent of oxygen. Since anoxia is a major cause of failure in cancer radiotherapy, there appears to be some advantage to the use of neutrons. The low penetration of neutrons in tissue in comparison to that high-voltage X-rays or ^{60}Co γ rays makes implantation of neutron sources within and around tumors appropriate. Californium-252 has been fabricated in the form of needles. It has a half-life of 2.6 yrs and 1 μg of ^{252}Cf is equivalent to 1 mg of radium. Use of ^{252}Cf for interstitial radiotherapy would combine the advantages of low-intensity irradiation (as with radium) with the advantages of high LET radiation. These advantages are being verified presently using cultured human tumor cells.

NSA

N69-14137# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PECULIARITIES OF THE CLINICAL COURSE OF PNEUMONIA FOLLOWING POISONING WITH BERYLLIUM COMPOUNDS

L. N. Belyayeva 21 Nov. 1967 11 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), v. 9, 1965 p 28–32

(AD-677248; FTD-MT-24-308-67) Avail: CFSTI CSCL 6/5

Pneumonia, which is the most serious and rather frequent complication of poisoning by beryllium compounds, develops in interstitial tissue against the background of toxic lesion of alveolae and bronchioles, which leads to partial atelectasis and swelling of separate pulmonary areas with considerable increase in the permeability of the pulmonary vessels. Development of pneumonia usually involves association of a secondary pneumotropic infection or activation of the primary one, which then acquires virulent properties. In view of essential changes of reactance of the organism, most beryllium pneumonias run the course of a hypoergic type without appreciable rise in body temperature, with moderate leucocytosis or normal leucocyte count, and without special shifts in the rods and nuclei. There is observed arterial hypoxemia, hyperventilation, and proclivity towards marked tachypnea, tachycardia, hypotonia and collapse-like conditions. Due to the protracted course of the pneumonic process the functional capacity of the respiratory and hemodynamic systems is slow to recover its normal vigor.

Author (TAB)

N69-14144# Columbia Univ., New York. Radiological Research Lab.

RESEARCH PROJECT Annual Report

H. H. Rossi 1 Jan. 1968 303 p refs

(Contract AT(30-1)-2740)

(NYO-2740-5) Avail: CFSTI

Separate abstracts were prepared on the three sections of this report. They include research in radiological physics, biophysics, and radiobiology.

NSA

N69-14149# National Center for Urban and Industrial Health, Washington, D. C. Occupational Health Program.
PHYSIOLOGICAL RESPONSES TO A CHANGING THERMAL LOAD
A. Henschel, C. Humphreys, T. Doyle, L. Margolies, and W. Carlson Sep. 1968 46 p
(AD-677386; TR-54) Avail: Issuing Activity CSCL 6/16

Two series of experiments were conducted. In series 1 the work load (metabolic heat production) was constant while the environmental heat load was increased stepwise at 45-minute intervals from comfort conditions to severe heat conditions. In series 2, the environmental heat load was constant while the metabolic heat load was progressively increased during the 45-minute intervals from light to moderate work levels. Comparative data were obtained from these experiments on the physiological responses to a changing environmental heat load and to a changing metabolic heat load which permitted an evaluation of differences in intra- and inter-individual responses to heat and the resulting physiological strain. Author (TAB)

N69-14177# School of Aerospace Medicine, Brooks AFB, Tex.
CHANGES IN WATER-SALT METABOLISM DURING A 62-DAY PERIOD OF HYPOKINESIS [IZMENENIE VODNOSOLEVOGO OBMENA V USLOVIYAKH 62-SUTOCHOI GIPOKINEZII]
E. N. Biryukov et al. [1968] 11 p refs Transl. into ENGLISH from Russian
(AD-677491; SAM-TT-R-947-0868) Avail: CFSTI CSCL 6/16

The picture of biochemical changes presented in the homeostasis of a healthy individual is nothing other than the ultimate manifestation of disorders in the neuro-secretory, compensatory processes elicited by prolonged restriction of movement and redistribution of the bodys fluid matrix. Author (TAB)

N69-14178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REANIMATION OF DOGS AFTER CLINICAL DEATH DUE TO THE EFFECT OF RADIAL ACCELERATOR
V. D. Yankovskyi, O. P. Morozov, and M. P. Adamenko Nov. 1967 10 p refs Transl. into ENGLISH from Fizol. Zh. (USSR), v. 12, no. 5, 1966 p 571–575
(AD-677262; FTD-HT-23-1265-67) Avail: CFSTI CSCL 6/3

The authors conducted a series of experiments and found that dogs can be reanimated following clinical death resulting from radial accelerations of up to 40 G by a method of artificial circulation. The longest periods of clinical death due to radial accelerations following which full restoration of functions could be attained varied from 15 min 45 sec to 19 min 30 sec. The reanimated dogs live for years, bear normal litters, and differ in no respect from normal dogs in behavior and work capacity. TAB

N69-14220# Albert Einstein Medical Center, Philadelphia, Pa. Dept. of Genetics.
ULTRAVIOLET LIGHT EFFECTS ON NUCLEIC ACID FORMATION AND GENETIC EVENTS IN BACTERIA Annual Progress Report
C. O. Doudney 29 Apr. 1968 13 p ref
(Contract AT(30-1)-3893)
(NYO-3893-1) Avail: CFSTI

Peroxide effects on survival and mutation induction were studied in bacteria exposed to uv and photoreversed. When uv-exposed *Escherichia coli* were incubated in the presence of hydrogen peroxide and yeast extract, a marked lethal effect was observed within 4 min. Results indicated that the interaction of the peroxides with some non-photoreversible uv damage causes considerable lethality but this interaction has little effect in inducing certain reversions to phototrophy in auxotrophic bacteria. Mutation frequency decline and photoreversal of uv-induced mutation in mtd+ and mtd- strains of *E. coli* were studied. It was found that photoreversal response of induced phototrophy corresponded to that of photoreversal of lethality in regard to amount of light expended, suggesting that photoenzymatic elimination of pyrimidine dimers is responsible for both responses. Studies on the effect of acriflavine on DNA and RNA formation in uv-damaged bacteria indicated the effects were related to the presence of the pyrimidine dimer. NSA

N69-14221*# Aztec School of Languages, Inc., Acton, Mass.
CERTAIN PROBLEMS OF THE ENERGIES OF LITHOTROPIC ORGANISMS
N. G. Domen and G. V. Tikhonova Washington NASA Dec. 1968 25 p refs Transl. into ENGLISH from Nekotoryye Probl. Energ. Organizmov-Litotrofov Usp. Sovrem. Biol. (USSR), v. 60, no. 2, 1965 p 238–256
(Contract NASw-1692)
(NASA-TT-F-12018) Avail: CFSTI CSCL 06A

The authors discuss certain problems in the energy exchanges of lithotropic organisms, particularly the Hydrogenomonas, Nitrosomonas, Nitrobacter, Thiobacillus and Desulfovibrio. Particular attention is centered on the role of the "reverse" electron transfer in the synthesis of the CO_2 reducing agent of such organisms. The possible ways in which the reducing agents and macroergs (prerequisites for the energy conversions) are developed are also presented. Author

N69-14246*# Scripta Technica, Inc., Washington, D. C.
ANALYSIS OF NUCLEAR FUNCTIONS IN THE ONTOGENETIC DEVELOPMENT OF THE FROG. 4: MODIFICATIONS OF THE CHROMOSOME FORMULA [CONTRIBUTION A L'ANALYSE DES FONCTIONS NUCLEAIRES DANS L'ONTOGENESE DE LA GRENOUILLE. 4: MODIFICATIONS DE LA FORMULE CHROMOSOMALE]
A. Dalcq NASA Dec. 1968 18 p refs Transl. into ENGLISH from Arch. Biol. (Belgium), v. 43, 1932 p 345–366
(Contract NASw-1694)
(NASA-TT-F-11945) Avail: CFSTI CSCL 06R

Earlier investigations had provided some evidence that the nuclear complex played some part in segmentation and gastrulation, attempts were now made to produce a fertilized ovum with a subhaploid chromosome formula. It was a matter of eliminating the paternal chromatin by irradiation or poisoning, and, on the other hand, removing part of the maternal haplome by puncture of the maturation spot. These attempts failed, whether because the residual chromosomes were always damaged to some extent indirectly or because gastrulation and neurulation require the presence of a complete and intact haplome. This negative conclusion was arrived at after cytological examination of the chromosomes of larvae which might provide the answer, together with examination of chromosomes from quite a considerable number of controls. Author

N69-14279# Illinois Univ., Urbana. Group Effectiveness Research Lab.
COMMUNICATION, COOPERATION, AND NEGOTIATION IN CULTURALLY HETEROGENEOUS GROUPS Quarterly Report
Fred E. Fiedler and Harry C. Triandis Oct. 1968 14 p refs
(Contract Nonr-1834(36); ARPA Order 454)
(AD-677670) Avail: CFSTI CSCL 5/10

A brief review is presented of current work on culture assimilators. TAB

N69-14329*# George Washington Univ., Washington, D. C. Medical Center.
BIBLIOGRAPHY ON INACTIVATION OF VIRUSES AND RICKETTSIAE BY HEAT
Mary Shipp Watson and Lydia M. Homann Nov. 1968 113 p refs
(Contract NSR-09-010-027)
(NASA-CR-98665) Avail: CFSTI CSCL 06M

This volume contains a bibliographic listing of 514 literature references concerning the inactivation of viruses and rickettsiae by heat. A permuted index and a complete author index are included. Author

N69-14340# School of Aerospace Medicine, Brooks AFB, Tex.
TRENDS IN AIRCREW ATTITUDES AND JOB-SATISFACTION: WIVES' REPORT
George K. Cantrell Jun. 1968 31 p
(AD-677188; SAM-TR-68-67) Avail: CFSTI CSCL 5/9

Part of the aircrew management survey is a short questionnaire to be completed by wives on a voluntary basis. Data from four groups were compared to reveal potential trends in the problem areas covered in the survey. This comparison revealed that, for officer wives, the largest favorable change involved a reduction in the number of days husbands spent on TDY and resulting improvement in the husbands ability to relax. The largest negative changes involved living conditions, cost-of-living, and the effect of the husbands frequent absences on the marriage. For airman wives, the largest favorable changes involved living conditions and cost-of-living, the average number of days husbands spent on TDY, and additional duties. The largest negative changes involved attitude toward husbands flying duties, effects of husbands absences on children, and greater difficulties experienced by husbands in relaxing. Descriptions of the modal officer and enlisted aircrewman were derived. Author (TAB)

N69-14348# School of Aerospace Medicine, Brooks AFB, Tex.
PSYCHOMOTOR EFFECTS OF LOW DOSES OF ACETAZOLAMIDE TO AID ACCOMMODATION OF MEN TO ALTITUDE
Bryce O. Hartman and Phelps P. Crump Jul. 1968 20 p refs
(AD-677187; SAM-TR-68-65) Avail: CFSTI CSCL 6/15

Studies were conducted to evaluate the usefulness of acetazolamide in aiding accommodation to altitude. Three experimental conditions were included in the studies: five men decompressed to a pressure altitude of 14,000 ft. for 6 hours; six men decompressed to 16,000 ft. for 4 hours; and three men decompressed to 14,000 ft. for 5 days. Each subject participated in two runs, one with administration of the drug and the other in placebo, using the usual double blind procedure. Author (TAB)

N69-14378# Tennessee Univ., Knoxville. Dept. of Psychology.
OPERATIONAL ANALYSIS OF BEHAVIORAL SITUATIONS Final Report, 1 Mar. 1967–30 Sep. 1968
William S. Verplanck Oct. 1968 57 p
(Grant AF-AFOSR-1269-67)
(AD-677607; AFOSR-68-2326) Avail: CFSTI CSCL 5/10

The project is concerned with the development and implementation of a procedure for the evaluation, reclassification, and the retrieval of the experimental evidence in psychology. Based on an empirical vocabulary, and utilizing an analysis of experimental reports into the specific operations carried out by the experimenter, analysis sheets and a notational code were developed, and are now being refined in use. The analysis sheet provides for succinct statement of each variable that enters into the experiment. The notation permits statement in coded form of the specific operations independently of the particular conditions of the experiment. The notational summary of the operations will provide the basis for reclassification of empirical findings. Using the bibliographic methods of a parallel research at the University of New Mexico, the original literature on the topic sensory preconditioning was evaluated and is now being summarized, as well as a randomly selected sample of approximately 300 papers. Author (TAB)

N69-14387*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY
Nov. 1968 191 p
(NASA-SP-7011(56)) Avail: CFSTI CSCL 06

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N69-14407#
MAN AND AUTOMATA IN SPACE
G. Petrov [1968] 3 p Transl. into ENGLISH from Pravda (Moscow), no. 358(18405), 23 Dec. 1968 5 p
Avail: CFSTI

The Soviet development of automated space probes, space stations, and manned spacecraft with additional full automatic control capability is briefly described. Docking maneuvers are discussed, and some of the risks of the Apollo 8 moon flight due to the emphasis on human control over automatic control are pointed out. K.W.

N69-14421# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMINAR ON NERVOUS SYSTEM FUNCTION MODELING
Ye. N. Sokolov 4 Dec. 1967 6 p Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 15, no. 1, 1965 p 188–189
(AD-677252; FTD-HT-23-1110-67) Avail: CFSTI CSCL 6/16

A seminar on problems involved in modeling nervous system functions on the individual neuron level, the neuron system level, and the level of the behavior of the entire organism, was held by Vilnyus State University from 4 to 11 July 1964. Representatives from six Soviet cities presented papers at the seminar. Author (TAB)

N69-14444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPACE PSYCHOLOGY
V. V. Parin et al 14 Dec. 1967 15 p refs Transl. into ENGLISH from Priroda (Erevan) no. 12, 1966 p 3–12
(AD-677689; FTD-HT-23-1067-67) Avail: CFSTI CSCL 5/10

Soviet and Western concepts of the selection and training of cosmonauts, effects of isolation, psychophysiological stress, and biological rhythms in space are reviewed. Author (TAB)

N69-14455# Martin Co., Denver, Colo.
A SOLAR-ILLUMINATED ALGAL PHOTOSYNTHETIC EXCHANGER
Richard L. Miller, Don W. Smith, Calvin H. Ward, Denzel L. Dyer, and Robert D. Gafford Brooks AFB, Tex. School of Aerospace Med. Jun. 1968 28 p refs
(Contract AF 41(609)-1606)
(AD-677116; SAM-TR-68-66) Avail: CFSTI CSCL 6/11

A continuous culture system was designed to study the use of solar energy for algal growth and photosynthetic gas exchange. Design parameters were calculated to support algal growth and photosynthesis during peak sunlight at a rate sufficient to provide respiratory support for one man. The unique feature of the system was the facility for orienting the panels to face and track the sun. Instrumentation was provided for monitoring the important variables affecting algal growth. Testing with the system spanned a three-year period and two geographical locations. Experimental results provided data on the operating parameters of a large solar-illuminated algal culture system and approximately confirmed the original calculations for algal production rate. Author (TAB)

N69-14491*# Naval Aerospace Medical Inst., Pensacola, Fla.
THE PROBLEM OF ARTIFICIAL GRAVITY IN SPACE FLIGHT Progress Report, 1 Jul.–31 Dec. 1968
Ashton Graybiel 31 Dec. 1968 7 p refs
(NASA Order R-93)
(NASA-CR-98662; PR-20) Avail: CFSTI CSCL 06S

This report summarizes progress in several studies concerned with the central nervous system, ataxia, vestibular activities, and motion sickness in connection with human adaptation to rotating environments. The work also covers adaptation by means of controlled head movements, the use of preventive drugs, and the etiological factors of motion sickness. K.W.

N69-14541*# Harvard Univ., Boston, Mass. Thorndike Memorial Lab.
A STUDY OF PHYSIOLOGICAL MECHANISMS AND INTER-RELATIONS BETWEEN SYSTEMIC AND REGIONAL BLOOD VOLUME, BLOOD FLOW AND ELECTROLYTE BALANCE Interim Progress Report
Walter H. Abelmann 31 Dec. 1968 8 p refs
(Grant NGR-22-007-019)
(NASA-CR-98660) Avail: CFSTI CSCL 06P

In experiments on the regulation of sodium excretion, the effects of fasting and re-feeding with carbohydrate were investigated in eight young, healthy obese volunteers who were hospitalized and maintained on a constant sodium, potassium, and water intake. The studies suggest that the natriuresis of starvation may be attributed to a decrease in distal tubular reabsorption and that the re-feeding of carbohydrate induces antinatriuresis by enhancing proximal tubular resbsorption. The relationship of valvular disease to sodium excretion is discussed briefly. Animal studies on the effects of atrial tachycardia and atrial fibrillation indicate that mean arterial pressure is a major factor in changes in tubular reabsorption of sodium associated with altered atrial rhythm. In evaluating the role of circulatory congestion, it was found that orthostatic tolerance in normal subjects was improved by expansion of plasma volume. It is also reported that cardiovascular deconditioning was not observed in patients with congestive heart failure who were treated with bed rest. Development plans for a miniature pressure transducer are mentioned. M.G.J.

N69-14542*# Aztec School of Languages, Inc., Acton, Mass.
INVESTIGATIONS OF AUTONOMOUS MOVEMENTS OF PRIMARY LEAVES OF CANAVALIA ENSIFORMIS DC [UNTERSUCHUNGEN UEBER DIE AUTONOMEN BEWEGUNGEN DER PRIMAERBLAETTER VON CANAVALIA ENSIFORMIS DC]
Anthonia Kleinhoonte Washington NASA Dec. 1968 37 p refs Transl. into ENGLISH from German
(Contract NASw-1692)
(NASA-TT-F-11975) Avail: CFSTI CSCL 06C

Data pertaining to the nyctinastic movements of leguminous leaves are reviewed, with particular attention centered on experiments to influence plants by noncyclical stimuli in such a way that they no longer experience circadian cycles. Details are given on several experiments concerning the autonomous nature of leaf movements, including experiments with the clinostat, with plants raised under continuous illumination, and with plants raised under 8:8-hour illumination cycling. Theoretical studies, pertaining to circadian autonomous movements and supplementary oscillations during nyctitropic movements, are discussed. Among the results reported are the following: (1) Further displacements of an already displaced movement occur in the same way as displacements from a normal condition. (2) Plants grown under constant illumination soon show a more or less well-shaped, approximately circadian movement. (3) Plants grown under 8:8-hour illumination cycling initially show movement synchronous with this cycle. Often this movement is abandoned and circadian autonomous periodicity is then developed synchronously with the change between day and night. M.G.J.

N69-14588*# Aztec School of Languages, Inc., Acton, Mass.
TWIN MALFORMATIONS ARISING IN THE COURSE OF CENTRIFUGATION OF FERTILIZED EGG-CELLS OF RANA TEMPORARIA PRIOR TO SEGMENTATION [VOZNIKNOVENIYE BLIZNETSOVYKH URODSTV PRI TSENTRIFUGIROVANII OPLODOTVORENNYKH YAYTSEKLETOK TRAVYANOY LYAGUSHKI DO DROBLENIYA]
V. L. Kas'yanov Washington NASA Dec. 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 180, no. 4, 1968 p 1008–1011
(Contract NASw-1968)
(NASA-TT-F-12075) Avail: CFSTI CSCL 06S

Methods are described by which groups of egg-cells of Rana temporaria were subjected to artificial insemination and subsequent centrifugation. The resistance of various developmental stages to this centrifugation is discussed in terms of the percentage of developed embryos and the percentage of twin malformations. It is also shown that a shaking of test tubes with groups of egg-cells has a weaker effect than does centrifugation. Author

N69-14587*# Techtran Corp., Glen Burnie, Md.
MOST ANCIENT MANIFESTATIONS OF LIFE ON EARTH [O DREVNEYSHIKH ZHIZNEPROYAVLENIYAKH NA ZEMLE]
A. G. Vologdin Washington NASA Dec. 1968 12 p refs Transl. into ENGLISH from Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR (Alma-Ata), v. 9, 1967 p 159–166
(Contract NASw-1695)
(NASA-TT-F-12043) Avail: CFSTI CSCL 06A

This essay represents a summary of information concerning the origin of life on earth as obtained by various scientists, including V. I. Vernadskiy, Stanley Miller, A. I. Oparin, and others. The work also includes some commentary on various problems encountered by science in its efforts to solve the mystery of the origin of life. The role of certain microorganisms and algae in the evolution of life, the atmosphere and mineralization during the Precambrian and Cambrian, and certain sedimentary strata containing these organisms are discussed. Author

N69-14891*# University of Southern Calif., Los Angeles. School of Medicine.
OBSERVATION OF ARTERIAL BLOOD PRESSURE OF THE PRIMATE AAP-Bio–A-1 Quarterly Progress Report, 10 Jul.–9 Oct. 1968
John P. Meehan 12 Nov. 1968 9 p
(Contract NSR-05-018-087)
(NASA-CR-98664) Avail: CFSTI CSCL 06B

During this reporting period major effort was concentrated in circuit development, acquisition of components, experimental

evaluation of implant sites and tentative scheduling. Three of the major circuits are either in the prototype packaging or in the final breadboard stage. Author

N69-14582*# Aztec School of Languages, Inc., Acton, Mass.
PRIMARY CARBONACEOUS COMPOUNDS AND THEIR CONVERSION IN NATURE [PERVICHNYYE UGLERODISTYYE SOYEDINENIYA I IKH PREVRASHCHENIYA V PRIRODE]
G. P. Vodvykin Washington NASA Dec. 1968 11 p refs Transl. into ENGLISH from Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR (Alma-Ata), v. 9, 1967 p 151–158
(Contract NASw-1692)
(NASA-TT-F-12044) Avail: CFSTI CSCL 07C

The development of primary carbonaceous compounds in meteorites and in the Earth's crust is described in this article. The author concludes that living matter is a particular form and a higher evolutionary stage of carbonaceous compounds, and that this living matter is the inevitable result of an advantageous development of all inorganic matter on the whole. He also discusses the similarities in the content and structure of the carbonaceous compounds found in outer space and on the Earth. Author

N69-14627*# George Washington Univ., Washington, D. C. Medical Center.
SCIENTIFIC PUBLICATIONS OF THE BIOSCIENCE PROGRAMS DIVISION, VOLUME 5: PLANETARY QUARANTINE
Mary Shipp Watson and Frances Hong 19 Nov. 1968 47 p refs 2d ed.
(Contract NSR-09-010-027)
(NASA-CR-98672) Avail: CFSTI CSCL 06A

Publications appearing as serial literature, monographs, books, reports, and speeches were used in compiling this bibliography. It consists of a list of citations arranged chronologically according to author's names, a permuted title index, an author index, and a senior author and laboratory directory. Author

N69-14654# Naval Submarine Medical Center, Groton, Conn.
CARBONIC ANHYDRASE ANALYSES OF THE BLOOD OF SUBJECTS EXPOSED TO A HELIUM-OXYGEN ENVIRONMENT AT SEVEN ATMOSPHERES PRESSURE
Donald V. Tappan and Michael J. Jaley Apr. 1968 7 p refs
(AD-676325; NSCM-MR-68-6) Avail: CFSTI CSCL 6/1

The carbon dioxide hydrating ability of erythrocytes measured as carbonic anhydrase activity and the qualitative pattern of the isozymes of this enzyme group were studied in men exposed to a helium-oxygen environment at seven atmospheres pressure. No alteration in the enzyme or its activity of apparent physiological significance was detected. Author (TAB)

N69-14661# Universidad Nacional de Trujillo (Peru). Departamento de Fisiologia.
THE ROLE OF CATECHOLAMINES AND SEROTONIN IN THE PROCESS OF ADAPTATION TO HIGH ALTITUDE Final Report
Arnoldo Medina, Luis Utano and Gilberto Olava Sep. 1968 11 p refs
(Grant AF-AFOSR-888-67)
(AD-676885; AFOSR-68-2087) Avail: CFSTI CSCL 6/19

This work is relationad with the study of the catecholamines and serotonin in the process of adaptation to high altitude. The effects of hypoxia (12.85% O2 in N2) on the pulmonary artery pressure of dogs have been studied, as well as the variations in the levels of Serotonin and Catecholamines in the blood of the same artery. Hypoxia produced pulmonary hypertension in the dogs studied, and at the same time an increase in the level of Serotonin in the blood of the pulmonary artery was produced. The dogs reserpinized had hypertension pulmonary. This result is expounded in relation to a reflex vasoconstriction, which is mediated by Serotonin. Author (TAB)

N69-14673*# Techtran Corp., Glen Burnie, Md.
SIMULATION OF WEIGHTLESSNESS BY RAPID ROTATION: ITS INFLUENCE ON VARIOUS ORGANISMS [SCHWERELOSIGKEITSSIMULATION DURCH RASCHE ROTATION: IHR EINFLUSS AUF VERSCHIEDENE ORGANISMEN]
W. Briegleb Washington NASA Jan. 1969 14 p refs Transl. into ENGLISH from German rept. BMwF-FB-W-68-30 Presented at the Symp. on Extraterrest. Biophys., Biol. and Space Med., Marburg, West Ger., 9–10 Oct. 1967 Submitted for publication
(Contract NASw-1695)
(NASA-TT-F-12040) Avail: CFSTI CSCL 06S

The author describes apparatus and procedures for simulating weightlessness by rapid rotation and for recording minute deviations in development due to that factor. He believes that this method has more evidential value than experiments thus far conducted on this point on satellites. Nevertheless, in experiments on cultures of *Chlorella pyrenoidosa* and *Phormidium* and on developing eggs of the beetle *Tribolium castaneum* he finds fully normal development with no significant deviations. He announces his intention of refining the method. In order to draw inferences bearing upon manned space flight he recommends study of the aquatic mammals dolphin and seal. Author

N69-14720# Northrop Corp., Hawthorne, Calif. Life Sciences Labs.
EFFECTS OF THE RATE OF DELIVERY OF IONIZING RADIATION ON THE LD $_{50/30}$ OF RODENTS Final Report, 15 Nov. 1966–15 Nov. 1967
Jerome J. Gambino and B. H. Faulkenberry Brooks AFB, Tex. School of Aerospace Med. May 1968 47 p refs
(Contract F41609-67-C-0004)
(AD-677185; SAM-TR-68-47) Avail: CFSTI CSCL 6/18

Mortality and shock-avoidance performance were observed in Wistar albino rats subjected to pulsed ionizing radiation from two different nuclear reactors. In one, the n/gamma dose ratio obtained ranged from 2.5/1 to 6.6/1, and the pulse width was 48 microsec. at half-amplitude. In the other, the pulse half-width was either 10 to 150 msec., and the n/gamma tissue dose ratio used ranged from 1/23 to approximately 5.3/1. Author (TAB)

N69-14734*# Techtran Corp., Glen Burnie, Md.
WATER-SALT METABOLISM DURING SPACE FLIGHTS [VODNO-SOLEVOY OBMEN PRI KOSMICHESKIKH POLETAKH]
I. S. Balakhovskiy Washington NASA Jan. 1969 16 p refs Transl. into ENGLISH from Russian Presented at the 19th Congr. of the Intern. Astronautical Federation, New York, Oct. 1968
(Contract NASw-1695)
(NASA-TT-F-12063) Avail: CFSTI CSCL 06S

In view of the fact that water–salt metabolism is not entirely understood, even under terrestrial conditions of weightlessness in space, the problem of human water–salt metabolism during space flights is considered and published data on this subject during space flights are summarized. It is assumed that weight loss is the result of losses of extra- or intracellular body fluids, apparently affected by nutrition and consumption of salts. Tests were conducted

on the crew of the Voskhod spacecraft in an effort to determine the changes which occur in human water metabolism during space flight. These tests are described and the results are summarized. Author

N69-14788# Army Edgewood Arsenal, Md.
ENDURANCE OF OVERHEATED MEN IN EXHAUSTING WORK
Francis N. Craig and Harry L. Froelich Jul. 1968 25 p refs
(AD-677359; EATR-4193) Avail: CFSTI CSCL 6/19

Men worked themselves to exhaustion on a treadmill at 3.5 mph and a grade beginning at 10 percent and increasing by one percent per minute in a room at 46 degrees C. The men were first overheated by enclosure in a plastic bag or by immersion in a warm bath. Enough water was drunk to prevent dehydration. Effects of dehydration on endurance in exhausting work at 46 degrees C, reported previously, appear to be due mainly to overheating during the period of water restriction. Author (TAB)

N69-14825# Saskatchewan Univ., Saskatoon.
AN ANALOGUE COMPUTER STUDY OF THE HUMAN CARDIOVASCULAR CONTROL SYSTEM
W. D. Pickering, P. N. Nikiforuk, and J. E. Merriman 1968 22 p refs
Avail: CFSTI

A simplified analogue computer model of the human cardiovascular control system is developed in this paper. This model can be adjusted to reproduce the response of a subject to a submaximal work-load. The validity of the model is evaluated and suggestions for its further development are included. Author

N69-14860*# National Aeronautics and Space Administration, Washington, D. C.
NASA CONTRIBUTIONS TO BIOINSTRUMENTATION SYSTEMS—A SURVEY
Gershon Weltman, Moshe Klagsbrun, Donald Ukkestad, and Ben Ettelson 1968 101 p refs Prepared by Spacelabs, Inc.
(NASA-SP-5054) Avail: SOD $1.00; CFSTI CSLC 06B

Advances in bioinstrumentation devices and techniques achieved by the National Aeronautics and Space Administration are described to facilitate use of NASA contributions in medicine and the bioinstrumentation industry. Accordingly, the survey is directed largely toward two groups: those in medicine who plan, specify, and utilize advanced bioinstrumentation systems; and those in engineering who design, develop, and manufacture them. The objectives are to stress the correspondence between spaceflight and nonaerospace applications and to lay the groundwork for subsequent extrapolation of NASA's experiences by the reader. Five main areas of NASA bioinstrumentation system development are identified: (1) *Planning*—The techniques to establish information requirements and equipment specification for system development are outlined. (2) *Sensing and signal conditioning*—Detection of physiological signals under aerospace conditions and design of advanced electronic instrumentation to process and transmit these signals are discussed. (3) *Medical monitoring and data processing*—Significant NASA contributions to data processing, including acquisition techniques, computation of derived parameters, and methods of data display are included. (4) *Measurements in the field*—Solutions to some difficult problems of making laboratory-quality measurements in the field are treated. (5) *Manufacture*—NASA contributions to bioinstrumentation fabrication and quality assurance are presented. Author

N69-14870# Naval Submarine Medical Center, Groton, Conn. Medical Research Lab.
TASTE THRESHOLDS TO BITTER COMPOUNDS DURING A SUBMARINE PATROL
John W. Nesson and William R. Shiller 25 Jun. 1968 11 p refs
(AD-677038; SMRL-538) Avail: CFSTI CSCL 5/9

Polaris submarines make two month patrols and are submerged without external ventilation during the entire time. The atmosphere is controlled to maintain habitability using CO, CO2 and H2 removers, as well as, O2 generators. The ambient CO2 is elevated during the entire patrol to an average level of 1.0%. In general, the atmospheric trace components of this closed environment are expected to differ from those found under normal environmental conditions. Past study has indicated a decrease in the taste threshold for the sour modality aboard submarines. This study was undertaken to test the effect of this atmosphere on the bitter modality threshold. Taste thresholds for quinine (bitter) were determined during the refit period while in port and used as a baseline. Three subsequent taste tests were accomplished during the patrol at about two week intervals. A borderline statistically significant decrease in taste threshold (more sensitive) for quinine was noted. A consistently higher threshold was noted in smokers than in non-smokers. Author (TAB)

N69-14935*# Department of the Army, Fort Detrick, Md. Protection Branch.
THE EFFECT OF DIMETHYL SULFOXIDE ON THE SPORICIDAL ACTIVITY OF ETHYLENE OXIDE GAS
David R. Spinar 9 Jan. 1969 9 p
(NASA Order R-35)
(NASA-CR-98741) Avail: CFSTI CSCL 06M

Tests were conducted to obtain a quick evaluation of whether there is an enhancement of the sporicidal activity of ethylene oxide (EtO) gas by incorporating dimethyl sulfoxide (DMSO). Previous screening tests, in which a cloth patch contaminated with *B. subtilis var niger* (BG) spores was suspended for 24 hours in a liter bottle over 0.1 ml of DMSO, revealed no measurable sporicidal activity; but a similar test with *Staphylococcus aureus* cells killed 100%, showing that DMSO is antibacterial. Similar 4-hour vapor tests were conducted using five chemicals, with and without 0.1 ml DMSO contained in a small glass weighing cup. A 0.1 ml amount of the other chemical was placed on the bottom of the bottle to volatilize. The activity of four of the chemicals was depressed by the presence of DMSO. One chemical's activity was not affected. Vapor pressure is probably an important factor here. It was noted that little of the DMSO had volatilized, and the liquid could be absorbing some of the other vapor. The vapor pressure of pure DMSO at 25° C is 0.6 mm Hg, which is equivalent to approximately 1.6 mg/liter. Author

N69-14838# School of Aerospace Medicine, Brooks AFB, Tex.
PRESENT AND FUTURE CONCEPTS FOR THE EVALUATION OF MAN'S CARDIOVASCULAR SYSTEM DURING SPACE FLIGHT [SOVREMENNOE SOSTOYANIE I PERSPEKTIVY ISSLEDOVANIYA SERDECHNO-SOSUDISTOI SISTEMY CHELOVEKA V KOSMICHESKIKH POLETAKH]
I. T. Akulinichev et al [1968] 9 p refs Transl. into ENGLISH from Russian Presented at 18th Congr. of Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(AD-677489; SAM-TT-R-944-0768) Avail: CFSTI CSCL 6/5

In processing diagnostic and symptomatic data, certain difficulties are unavoidable because of limited data during flight and because of diversity of adopted methods, and electrode characteristics. In this light, standardization of the research methods employed, of the data processing and sensory instrumentation is of essence. Such standardization could promote use of space medicine methodology in clinical practice, which in turn would provide an additional check of their effectiveness. Author (TAB)

N69-14976# Cambridge Univ. (England). Dept. of Zoology.
THE CONTROL OF CIRCADIAN ACTIVITY IN COCKROACHES Final Report
J. E. Harker 9 Mar. 1968 29 p refs
(Grant AF-EOAR-65-19)
(AD-677609; AFOSR-68-2174) Avail: CFSTI CSCL 6/3

A study was made of the concentration of potassium and sodium in the blood of Periplaneta americana to determine whether daily fluctuations occur which might imply ionic control of the circadian locomotor activity rhythm. Analyses were carried out on 166 blood samples taken at different times of day. A fall of about 10% occurred in the potassium concentration during the first hour of darkness; there was also a small decline of 2% in the sodium concentration. However, series of 6 successive blood samples taken over a period of 3 weeks from 10 individual cockroaches revealed no daily change in the level of potassium, sodium or haemocyte density. No conclusions are drawn on the activity control aspect, but the results do suggest that daily changes may occur in cockroach blood ions. Author (TAB)

N69-14992# Stanford Univ., Calif. Dept. of Computer Science.
ARTIFICIAL INTELLIGENCE PROJECT
John McCarthy, Edward Feigenbaum, and Arthur Samuel 13 Sep. 1968 93 p refs
(Contract ARPA SD-183; ARPA Order 457)
(AD-677528; SU-AI-69) Avail: CFSTI CSCL 6/4

Recent work of the Stanford Artificial Intelligence Project is summarized in several areas: Scientific hypothesis formation; Symbolic computation; Hand-eye systems; Computer recognition of speech; Board games; and Other projects. Author (TAB)

N69-14993# Army Biological Labs., Fort Detrick, Md.
AN EXPERIMENT ON THE DISINFECTION OF SURFACES WITH CHLORAMINE AEROSOLS
V. G. Kern et al Sep. 1968 8 p Transl. into ENGLISH from Zh. Mikrobiol., Epidemiol. i Immunobiol. (Moscow), v. 27, no. 4, 1956 p 112–115
(AD-676997; TRANS-88) Avail: CFSTI CSCL 6/12

Aerosols of chloramine solutions can be utilized for the dispersion of disinfection mediums on surfaces of premises and furniture during intestinal and droplet infection. The suggested method of obtaining the aerosols through the use of compressed air insures: (a) a large dispersion of the disinfecting solution and its deep penetration; (b) an even cover of the surface with small particles of the dispersed solution and a high effectiveness; (c) the desirable direction of the stream of aerosol; (d) disinfection of the air medium; (e) a great economizing of the disinfecting mediums. The surfaces are not damaged during the use of aerosol methods. The ability to obtain compressed air from portable compressor units which operate on ordinary electrical currents allow using the aerosols for disinfection in any locality. Author (TAB)

N69-14996# Defense Research Board, Ottawa (Ontario).
DECOMPRESSION CALCULATIONS: ANALOGUE AND DIGITAL METHODS
R. S. Weaver, L. A. Kuehn, and R. A. Stubbs May 1968 44 p refs
(DRET-703) Avail: Issuing Activity

In a previous report, a theoretical model was proposed to predict the response of an experimentally validated pneumatic decompression computer. Equations derived from the theoretical model were found to be non-linear, and no analytic solutions were obtainable. This paper reports in detail the analogue and digital computer programs developed to obtain solutions for the equations. The equations are shown to predict accurately the response of the pneumatic decompression computer to a standard pressure test procedure. Curves obtained from the computer programs are presented which relate ascent time to time at constant depth in diving situations, ascent height to time after surfacing for flying after diving, and nil-decompression diving to supersaturation ratio during ascent. The latter program shows that for air the supersaturation ratio 1.8 agrees extremely well with previous experimental results; this ratio is used in the current pneumatic decompression computers. Author

N69-15009*# National Aeronautics and Space Administration, Washington, D. C.
THE INFLUENCE OF MECHANICAL RESTRAINT AND OF BURDEN ON NYCTITROPIC MOVEMENTS [DER EINFLUSS VON MECHANISCHER HEMMUNG UND VON BELASTUNG AUF DIE SCHLAFBEWGUNGEN]
W. Pfeffer Dec. 1968 113 p refs Transl. into ENGLISH from Akad. Wiss. Math.-Phys. Klasse (Leipzig), v. 32, 1911 p 161–295
(NASA-TT-F-11984) Avail: CFSTI CSCL 06C

An investigation on nyctitropic movements of leaf organs with variable joints was conducted over prolonged periods of restraint and duly recorded. It was also determined if, as the result of displacement of illumination times, analogous reactions are triggered in freely moving leaves and in leaves whose execution of movements is restrained. A detailed exposition is presented on the subjects. Some of the results follow. The movement efforts on which nyctitropic movements are based are continuously sustained in the joint even when execution of the strived for movements are prevented by a resistance. If the execution of this strived for movement is prevented by a resistance, the leaf reacts to illumination changes in a manner similar to the freely moving leaf. Significant autonomous movement activity was observed after nyctitropic movements died out, as a result of the establishment of continuous illumination, both in the free leaf as well as in the leaf working against resistance. B.P.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N69-13926*# Michigan Univ., Ann Arbor.
SKILL TRAINING FOR THE PRODUCTION OF A MEMORIZED MOVEMENT PATTERN
Margaret Robb and Richard W. Pew Washington NASA Dec. 1968 37 p refs
(Contract NASR-54(06))
(NASA-CR-1251) Avail: CFSTI CSCL 05H

Based on the assumption that man may be regarded as an information processing system, experiments were conducted to assess the efficacy of several kinds of feedback information. Five groups of subjects were trained under different feedback conditions in the execution of a distinctive movement pattern. In a subsequent test condition, all groups attempted to reproduce the movement pattern without the aid of any external concurrent feedback. The training conditions, reflecting different modes of feedback, were blanked, vision, vision-blanked, passive-active, and slow-standard. The main variables were the types of terminal and concurrent feedback administered to the subjects through internal and external modes. Performance was compared in terms of integrated absolute error scores and in terms of a more detailed performance criterion that attempted to separate out performance precision with respect to amplitude and timing accuracy. The results are graphically depicted and it is hypothesized that the stage during training at which augmented feedback is introduced may be important. M.G.J.

N69-13989*# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

RAPID (EXPLOSIVE) DECOMPRESSION EMERGENCIES IN PRESSURE-SUITED SUBJECTS

Emanuel M. Roth Washington Nov. 1968 129 p

(Contract NASr-115)

(NASA-CR-1223) Avail: CFSTI CSCL 06S

A review is presented of the biomechanical factors determining lung damage following explosive decompression of space suits in vacuum test chambers. Critical variables, such as ratio of free volume of suit to area of orifice, pressure ratio, and pressure differential, are outlined. Calculations were made of orifices caused by catastrophic disruption of typical soft and hard space suits at seal sites, and predictions were made as to the likelihood of lung damage, based on the location of the seal disruption and open/closed glottis conditions. It was concluded that all seal areas should be designed for slow propagation of disruptive processes, and that preparation of therapeutic devices and facilities for handling explosive decompression emergencies would be advisable. It was found that use of gases other than 3.7 psia O_2 in the suits alters the hazard; the higher the percentage of helium in the mixture, the less is the hazard. Also, since the maximum possible amplitude of transmural pressure is determined by the pressure difference, the higher the initial pressure in the suit, the more hazardous the exposure. The pathological physiology of explosive decompression was reviewed, followed by a summary of the most recent ideas in selection and testing of subjects to reduce the hazard and the treatment of individual syndromes and conditions. Author

N69-14012*# Northeastern Univ., Boston, Mass. Electronics Research Lab.

A STUDY OF MICROMINIATURIZED DEVICES FOR BIASTRONAUTICAL MONITORING OR ANALYSIS

B. L. Cochrun and J. S. Rochefort 1 Sep. 1968 57 p refs

(Grant NGL-22-011-024)

(NASA-CR-98599; REPT-2) Avail: CFSTI CSCL 06B

A literature survey on blood oximetry confirmed previous conclusions that it would be advantageous to use solid state devices such as electroluminescent diodes, photosensitive diodes, and monolithic circuitry. An overview is presented on (Ga, Al) as growth experiments, and on the construction of a prototype modular electrode buffer amplifier (MEBA). A literature search was also conducted on electrodes for long-term physiological monitoring with particular reference to such problems at the skin-electrode interface as electrode polarization, motion artifact between electrode and skin, and subject discomfort. The results indicate that the use of electrode jelly is no longer necessary and that dry electrodes are preferable although their lifetime is limited to about two weeks. It is also reported that a hypothetical digital filter was postulated; the transfer characteristic was expressed in the Z-transform; the values of coefficients were determined; and a computer program was employed to assess the frequency response sensitivity to parameter variation. Admittance matrices are given for active circuit synthesis using uniform and exponential RC distributed lines. Bibliographies are included. M.G.J.

N69-14025*# Techtran Corp., Glen Burnie, Md.

SOME MECHANISMS RESPONSIBLE FOR THE REDUCTION OF ORTHOSTATIC STABILITY IN EXPERIMENTS WITH SIMULATED WEIGHTLESSNESS

I. D. Pestov Washington NASA Dec. 1968 11 p refs Transl. into ENGLISH from "Nekotoryye Mekhanizmy Snizheniya Ortostaticheskoy Ustoychivosti v Eksperimentakh s Imitatsiyey Nevesomosti" Presented at the 19th Congr. of the Intern. Astron. Federation, New York, Oct. 1968

(Contract NASw-1695)

(NASA-TT-F-12064) Avail: CFSTI CSCL 06S

In 41 experiments involving 18 hours water immersion (18 test subjects) it was established that compensated and noncompensated forms of orthostatic instability arise with identical changes in water volume and therefore cannot be determined by the level of dehydration of the organism alone. Orthostatic collapse appears most frequently in test subjects with unstable vegetative functions and an inclination to vestubular-vegetative reactions. It can be prevented by using pharmacological stimulants (strychnine, caffeine, phenamine). Apparently, one mechanism of compensation of the functions in the vertical pose is the nervous-reflector mechanism. An experiment involving 70 hours bed confinement showed a reduction in the tonality of the vessels in the lower extremities, which partially facilitates compensation of orthostatic shifts. Maintenance of normal tonality of these vessels by femoral occlusion collars increases the reserve capacity of the blood depot and orthostatic disorders. It is probable that when femoral collars are used this negative effect predominates over the effects for which it is designed. Author

N69-14093*# Philco-Ford Corp., Palo Alto, Calif. Western Development Labs.

PHYSIOLOGICAL MONITORING TECHNIQUE USING UNATTACHED SENSORS

Mylen Fitzwater, dePaul Corkhill, Earl Jackson, Paul Halverson, and Werner Sepper Mar. 1968 97 p refs

(Contract NAS12-121)

(NASA-CR-86048) Avail: CFSTI CSCL 06B

This report describes the development of techniques using unattached sensors for measuring Lead I electrocardiograph, impedance respiration, impedance pulse, thoracic sounds, and galvanic skin response. Two unattached sensor systems for recording these variables have been built and are described in detail. Studies were performed to determine the measurements taken with the unattached sensor monitoring system compared with conventional methods. Feasibility studies were performed to determine the capability of deriving additional information from characteristics of the obtained measures; these include: 1) heart rate determination from ECG and pulse channels, 2) emotional impedance changes comparable to galvanic skin response, 3) myographic (muscle potential) level from ECG signals. Results obtained using palm-to-palm dry unattached electrodes are comparable to conventional methods. However, further circuit design changes are planned based on recent validation studies. The developed techniques may be applicable to monitoring astronauts. Author

N69-14094*# Kentucky Univ., Lexington.

AN INVESTIGATION OF THE SUITABILITY OF WHITE RATS FOR SUB-ORBITAL STUDIES OF BEHAVIOR IN A GRAVITY FIELD

A. B. Broderson and K. O. Lange Washington NASA Dec. 1968 102 p refs

(Grant NsG-458)

(NASA-CR-1255) Avail: CFSTI CSCL 06C

Techniques were developed for evaluating the Sprague Dawley rat as a subject for the first of four in-flight gravity preference experiments to be launched into suborbital trajectories by Aerobee 150A rockets. Special configuration centrifuges were developed and used to experimentally determine the locomotion behavior of rats in fields of simulated gravity. Techniques were developed for investigating the effect of rocket launch stress on this behavior, and an environmental simulation system was developed and used to routinely prepare rats for the confinement, acceleration, spin, noise, and vibration of an Aerobee launch. The suitability of the subject and the effectiveness of the environmental simulation routine were verified by the satisfactory behavior demonstrated in the first flight experiment. Author

N69-14145*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
HUMAN VISUAL SAMPLING PROCESSES: A SIMULATION VALIDATION STUDY
John W. Senders, Jaime R. Carbonell, and Jane L. Ward Washington NASA Jan. 1969 110 p refs
(Contract NAS1-5059)
(NASA-CR-1258; BBN-1681) Avail: CFSTI CSCL 05H

The results obtained in some fundamental investigations strongly support the notion that the behavior of the pilot or controller/monitor is largely determined by, and calculable on, the basis of physical characteristics of the system. Based on the results a validation study more nearly approaching operational situations was undertaken. This study used an instrumented flight simulator, operational pilots, and complete measuring, recording, and analysis techniques to validate and improve the methods offered by the theory. The applied goal of the program was to make possible an a priori evaluation of the work load which any set of information sources to be monitored and controlled will place on the man. The following results were obtained: a measure of the goodness of prediction of the Nyquist models, and the development and a measure of goodness of prediction of a new queueing/cost-effectiveness model. Author

N69-14153# Martin Co., Orlando, Fla.
TARGET ACQUISITION STUDIES: FIXED TELEVISION FIELDS OF VIEW Final Report, Feb. 1967–Oct. 1968
Halim Ozkaptan, James G. Omart, James W. Bergert, and Robert A. McGee Oct. 1968 109 p refs
(Contract N00014-67-C-0340)
(AD-677322; OR-9656) Avail: CFSTI CSCL 17/8

A study was conducted to investigate an operators target acquisition capability while viewing a television monitor. The study was conducted under realistically simulated flight conditions in the Guidance Development Center of the Orlando Division of Martin Marietta Corporation. Pilot performance, in terms of search, detection, and recognition, was assessed for both briefed and unbriefed missions. It was found that: Performance as a function of contrast is strongly dependent upon field-of-view and type of briefing; Probability of detection is influenced by field-of-view only in the unbriefed mode; Extensive target search requirements exist in briefed as well as unbriefed modes. Author (TAB)

N69-14212*# Systems Technology, Inc., Hawthorne, Calif.
SMALL PERTURBATION DYNAMICS OF THE NEUROMUSCULAR SYSTEM IN TRACKING TASKS
Raymond P. Magdaleno, Duane T. Mc Ruer, and George P. Moore Washington NASA Dec. 1968 133 p refs
(Contract NAS2-2824)
(NASA-CR-1212; TR-154-1) Avail: CFSTI CSCL 05H

Existing physiological data and human operator describing function data are synthesized by providing models which are compatible with the overall human operator's input/output characteristics, as well as with the individual components of the neuromuscular system in tracking situations. Of interest are recent anatomical and physiological data for the muscle spindle and input/output studies of the muscle which indicate that quasi-linear models can describe the basic behavior of these elements in tracking tasks. Two key developments are reported: 1) variation in muscle system parameters as a function of average muscle tension or operating point, and 2) the role of the muscle spindle both as an adaptive equalization element and in its effect on setting muscle tone or average tension. The pertinent whole human data include the covariation of high and low frequency describing function phase data and the variation of high frequency phase with set tension changes interpreted from force disturbance experiments. Author

N69-14213*# Case Western Reserve Univ., Cleveland, Ohio.
A LUNAR GRAVITY SIMULATOR, VOLUME 3
Dennis A. Millett Washington NASA Dec. 1968 252 p refs
(Contract NAS1-7459)
(NASA-CR-1235) Avail: CFSTI CSCL 14B

Magnetic air bearings for use as low friction overhead support fixtures in a vertical lunar gravity simulator were investigated. This device consists of a flat magnetic disc with a central air orifice. The theoretical analyses of the air bearing are in good agreement with experiment. Theoretical magnet force ranged from 15% to 35% above the experimental value. Disc ceramic magnets were theoretically optimized based on maximum force-to-weight ratio and design curves are presented. Author

N69-14271# Busche Associates, Northridge, Calif.
ANIMATED PANEL LOGIC PROGRAMMING TECHNIQUES Final Engineering Report, Jun. 1967–May 1968
Orlando, Fla. Naval Training Device Center Sep. 1968 24 p
(Contract N61339-67-C-0201)
(AD-677476; NAVTRADEVCEN-67-C-0201-1) Avail: CFSTI CSCL 5/9

The study was concerned with methods, materials and techniques for producing panel artwork and equipment for programming and sequence control as applied to animated training panels. Two basic methods of producing the display panel itself were investigated. Both allow easy and rapid conversion of the artwork from one training problem to another. Both room light visable and controlled visability systems of artwork illumination were studied. A punched card programming system was advanced which promises much flexibility and ease of program change while retraining a simple easily understood mechanization. It permits excellent control of the training sequence by the instructor and its simplicity and obvious operational concept allows the instructor to modify or generate his own sequences. Author (TAB)

N69-14298# Army Natick Labs., Mass. Clothing and Organic Materials Lab.
FACTORS INFLUENCING THE IMPACT ENERGY ATTENUATION CAPABILITIES OF THE U.S. ARMY FLYER'S PROTECTIVE HELMET (AFH-1)
Abraham L. Lastnik Jul. 1968 18 p refs *Its* Ser. CE-ED-48
(AD-677119; TR-69-21-CM) Avail: CFSTI CSCL 6/17

Quality assurance impact testing of the U.S. Army's standard flight helmet, was conducted, in particular factors that influence the impact energy attenuation capabilities of the helmet were tested. The Armys specification requires that the helmet shall sustain two successive impacts in each of four designated sites without bottoming or transmitting an excess of 300 Gs to an instrumented headform. Because of the helmets configuration and construction, the sides exhibited the greatest ability to attenuate impact energy, followed in descending order by the front and rear areas of the helmet. Author (TAB)

N69-14341# Dunlap and Associates, Inc., Santa Monica, Calif.
ADAPTIVE PERFORMANCE MEASUREMENT Final Report
Charles R. Kelley and Daniel J. Prosin Aug. 1968 69 p refs
(Contract Nonr-4986(00))
(AD-677049) Avail: CFSTI CSCL 6/16

Adaptive human performance measurement is measurement in which the subjects response is fed back to affect the measurement process, modifying stimuli, problems, or the measurement apparatus. Research from related fields was analyzed to search out different adaptive measurement techniques. The most important other technique was measuring by modeling, in which the parameters of a model which adapts to match subject performance are the measurements. Experimental demonstrations of adaptive measurement include: (1) fixed and adaptive measurements of visual acuity; (2) a computer simulation of adaptive visual acuity runs; and (3) adaptive measurements of shape perception and of auditory binaural intensity discrimination. Application of the technique is discussed. Author (TAB)

N69-14345*# Louisville Univ., Ky.
EFFECTS OF PRACTICE AND WORK LOAD ON THE PERFORMANCE OF A CODE TRANSFORMATION TASK (COTRAN)
Earl A. Alluisi and Ben B. Morgan, Jr. Washington NASA Dec. 1968 73 p refs
(Grant NGR-18-002-008)
(NASA-CR-1261) Avail: CFSTI CSCL 05H

Results are presented on the effects of practice and operator work load on the acquisition and performance of a code-transformation (COTRAN) task, which was developed to obtain performance measurements of that part of intellectual functioning which is typically called non verbal mediation; it follows the problem-solving paradigm. During the acquisition phase, 27 COTRAN problems were solved on each of four (Group-4, with four subjects), eight (Group-8, with twenty subjects), or twelve (Group-12, with four subjects) successive days. Performance reached asymptotic levels in four to six sessions, in general, and the differences in final levels of performance of the three groups (4, 8, and 12) were not statistically significant. During the transfer phase, each of the 28 subjects solved 27 COTRAN problems of each of five successive days while time-sharing the COTRAN task with different combinations of tasks selected from a multiple-task performance battery. The results indicated that skilled COTRAN performance is sensitive to at least two or three levels of work-load stress, and that different subjects may tend to adopt different strategies in time-sharing the COTRAN task with other tasks. Author

N69-14457# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENT FOR SYNCHRONOUS SWITCH OF SIMULATORS AND CONTROL-MEASURING DEVICES
O. T. Lebedev et al 15 Dec. 1967 7 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 51, no. 7, 1965 p 895-896
(AD-677237; FTD-HT-23-1158-67) Avail: CFSTI CSCL 6/2

An electronic circuit has been designed by means of which the stimulant and a number of control and measuring devices are switched on simultaneously in experiments in which the dynamic characteristics of analysers (visual, auditory, etc.) are studied. Application of the circuit proposed eliminates the shortcomings connected with the use of electromechanical relays. The arrangement in question is suitable for the study of conditioned reflexes. TAB

N69-14478*# Dunlap and Associates, Inc., Darien, Conn.
PERIPHERAL VISION DISPLAYS, PHASE 2 REPORT
Leroy L. Vallerie Washington NASA Dec. 1968 49 p refs
(Contract NAS12-88)
(NASA-CR-1239; BSD-68-643) Avail: CFSTI CSCL 05H

Two commercially available display systems were investigated in conjunction with other concepts involving the use of flicker to encode airspeed signals and differential brightness to enhance the discriminability of input signals. Tracking information was presented in three control dimensions: viz., pitch, roll and airspeed. An adaptive loop simulator was employed to evaluate operator performance. The results clearly indicated that effective control can be exercised using peripheral displays employing changes in motion as the primary encoding stimulus. A higher level of performance was achieved with one system which contained a single display for presenting integrated pitch and roll signals. The addition of airspeed was found to degrade performance in pitch and roll under all display conditions. Performance could not be enhanced by means of differential brightness. Further evidence was provided for the use of motion as a very effective means for encoding displays designed for viewing in the periphery. Author

N69-14484# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDY OF ACOUSTIC PROPERTIES OF SPEECH SOUNDS
Kenneth N. Stevens and Mary M. Klatt Aug. 1968 95 p refs
(Contract F19628-68-C-0125; ARPA Order 627)
(AD-676979; BBN-1669; AFCRL-68-0446; SR-8) Avail: CFSTI CSCL 17/2

The spectral and temporal characteristics of American English vowel and consonant sounds in a variety of phonetic contexts are examined and compared with data reported in the literature. Spectrograms and sampled spectra (obtained from an analog filter bank connected to a digital computer) were assembled for a number of monosyllabic and bisyllabic utterances generated by three talkers, and a variety of measurements were made from these displays. The characteristics examined include durations of vowels, durations of various phases of consonants in prestressed and poststressed positions and in clusters, spectra of vowels and diphthongs and their variation with time, spectra of consonants during constricted intervals, and time-variation of spectra during the release of consonants. The aim of the study is not to present an exhaustive acoustic-phonetic description of American English speech sounds but rather to indicate the kinds of acoustic properties that need to be utilized in schemes for machine recognition of speech. Author (TAB)

N69-14494*# Garrett Corp., Los Angeles, Calif. AiResearch Manufacturing Div.
DEVELOPMENT OF AN ELECTROLYTIC SILVER-ION GENERATOR FOR WATER STERILIZATION IN APOLLO SPACECRAFT WATER SYSTEMS. APOLLO APPLICATIONS PROGRAM Final Report
C. F. Albright, R. Nachum, and M. D. Lachtman Jun. 1967 133 p refs
(Contract NAS9-3541)
(NASA-CR-65738; REPT-67-2158) Avail: CFSTI CSCL 06K

An electrolytic water sterilizer was developed for control of microbial contamination in the Apollo spacecraft. Individual units are self-contained and require no external power or control. The small size (2.5-in. diameter by 4 in. long), light weight (0.6 lb), and absence of interface requirements make it possible to incorporate such sterilizers at various desirable locations in the potable water system or the waste water system. The sterilizer produces silver ions in concentrations of 50 ppb to more than 200 ppb in the water flow system, the desired concentration being adjusted to the average water flow rate. After installation, no maintenance is required. The unit can be neglected with no damage to the cell or the system, since it becomes self-limiting if water flow is shut down. An external shunt is provided for on-off functions and monitoring of current flow. Probable life expectancy is 9000 hr without a change of batteries. Laboratory tests under simulated conditions have demonstrated essentially complete kill of *Staphylococcus aureus* and *Escherichia coli* within 8 hr, using initial bacterial concentrations greater than 5×10^5 organisms per ml. Author

N69-14620# Human Factors Research, Inc., Santa Barbara, Calif.
GEOGRAPHIC ORIENTATION IN AIRCRAFT PILOTS. A FIELD VALIDATION OF A POST-FLIGHT METHOD OF REPORTING NAVIGATION PERFORMANCE
Gail J. Borden and James J. McGrath Jul. 1968 88 p refs
(Contract Nonr-4218(00))
(AD-677055; JANAIR-680714; HFR-TR-751-14) Avail: CFSTI CSCL 5/10

In a previous study, a method was developed for obtaining navigational data from operational missions by means of postflight reports by the pilot. In this study, a series of flight tests were conducted to determine the validity of navigational data obtained by that method. Two fixed-wing squadrons and two rotary-wing squadrons flew a total of 39 low-altitude sorties, and an objective

record of the track of each sortie was obtained. During fixed-wing sorties, the objective track was determined by chase pilots; during rotary-wing sorties it was determined by Decca Flight Logs. After each sortie, the pilot marked on his aeronautical chart the track he recalled having flown. Measurements of navigational errors were made from the objective tracks and compared with those made from the recalled tracks. Author (TAB)

N69-14622# School of Aerospace Medicine, Brooks AFB, Tex. Otolaryngology Branch.
SOUND ATTENUATION PROVIDED BY PERFORATED EARMUFFS
Harrell C. Sutherland, Jr. and James E. Endicott Sep. 1968 11 p refs
(AD-677190; SAM-TR-68-86) Avail: CFSTI CSCL 20/1

Sound attenuation characteristics were determined for two types of earmuffs with perforated shells. The muffs had been perforated to allow air pressure equalization when used in a chamber where rapid barometric pressure changes take place in the presence of highly intense noise. It was found that both types of perforated muffs provided a substantial amount of ear protection even though they were not as effective as intact muffs. Author (TAB)

N69-14660 South Carolina Univ., Columbia.
SPEECH COMPRESSION
Hideo Seo (Ph.D. Thesis) 1967 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3942

An improved method of time compression of speech, utilizing the digital computer is presented. The use of the method to increase the communication capacity of the ear as the vital channel in audio communications is also described. The method yields time compressed speech which is natural of normal pitch, and highly intelligible, even at compression ratios of two. It utilizes a systematic approach in which portions of phonemes are sectioned out without destroying cognitive qualities. A sample of speech, recorded in regular audio tape is fed to the AD converter attached to the IBM system 7040. The digitized data is then analyzed and the optimum control of trimming out sections of the above record is accomplished by a method which trims out highly redundant sections and which minimizes the transients. The resultant digital output is subsequently converted to analog data by the DA converter. Dissert. Abstr.

N69-14728*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PILOT CURRICULUM AND INSTRUCTOR'S GUIDE EMPHASIZING SAFETY IN COMPRESSED GASES AND CRYOGENIC LIQUIDS
Edwin M. Logan and William T. Kitts Feb. 1968 101 p refs
(NASA-TM-X-58022) Avail: CFSTI CSCL 05I

The Curriculum Guide was prepared to assist both instructors and those persons interested in the presentatin of various safety aspects of industrial gases and cryogenic liquids. Safety is emphasized as concerns gases and cryogenic liquids at the Manned Spacecraft Center, Houston, Texas. Publications, audiovisual aids, and equipment devices in this field are included in the course. Author

N69-14768*# Michigan Univ., Ann Arbor.
PROPRIOCEPTIVE CUES AND THEIR INFLUENCE ON OPERATOR PERFORMANCE IN MANUAL CONTROL
James Herman Herzog Washington NASA Jan. 1969 178 p refs
(Contract NASr-54(06))
(NASA-CR-1248) Avail: CFSTI CSCL 05H

The neuromuscular control system of the human upper limb was investigated as an auxiliary source of sensory information. Analysis of a functional block diagram of the human operator indicated that a control system with interesting characteristics could be devised if the control stick were constructed to be a mechanical analog of the plant being controlled. This is called the matched manipulator control technique, in which the control force applied to the plant is a scalar multiple of the reaction force experienced by the operator. The operator is in a particularly advantageous position to formulate control strategies to emphasize either accurate control performance or minimum use of control effort. Experimentation with several human operators indicated that performance with the matched manipulator technique was consistently superior to control of the same plants with position type control sticks. This technique seems to offer an interesting and useful means of altering the interface between the human operator and his electro-mechanical surroundings in order to improve the system performance. Author

N69-14972# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
SOLID STATE IMAGE INTENSIFIERS, APPLICATION OF LIGHT AND IMAGE INTENSIFICATION TECHNIQUES TO MILITARY TRAINING, PHASE 4 Annual Report, Apr. 1966–Apr. 1967
Zoltan Szepesi and Michael A. Novice Orlando, Fla. Naval Training Device Center Jun. 1968 23 p refs
(Contract N61339-66-C-0064)
(AD-673980; NAVTRADEVCEN-66-C-0064-1) Avail: CFSTI CSCL 9/1

The objectives of this contract were: (1) to improve reproducibility and uniformity of image intensifier panels: (2) to improve speed of response and output brightness; (3) to prove feasibility of building image intensifier panels in modularized construction; (4) to have a black and white output image; and (5) to be able to view the image in moderately illuminated rooms. The most effort during the first year of this program was spent on the study of reproducibility, some problems of the modularized construction were solved. Image intensifiers with white output light have been built, problems of ambient light viewing have been analyzed and the necessary techniques experimented. No appreciable improvement was achieved in speed of response and output brightness. Author (TAB)

N69-14975# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
SOLID STATE IMAGE INTENSIFIERS, APPLICATION OF LIGHT AND IMAGE INTENSIFICATION TECHNIQUES TO MILITARY TRAINING, PHASE 4, PROJECT LIT Final Report
Zoltan Szepesi, M. A. Novice, and T. G. Keeton Orlando, Fla. Naval Training Device Center Jul. 1968 61 p refs
(Contract N61339-66-C-0064)
(AD-673981; NAVTRADEVCEN-66-C-0064-2) Avail: CFSTI CSCL 9/1

The objectives of the contract were: (1) to improve reproducibility and uniformity of image intensifier panels: (2) to improve speed of response and output brightness: (3) To prove feasibility of building image intensifier panels in modularized construction: (4) To have black and white output image: and (5) To be able to view the image in moderately illuminated rooms. most of the objectives of this program have been closely approached. The reproducibility and uniformity of small intensifier units have been improved, also, the spectral response at the lower end of the visible spectrum has been increased. A modularized image intensifier panel, consisting of nine modules of 2 inches ±2 inches has been built with acceptable uniformity and yield of fabrication. It had white output light and the image could be viewed in an ambient illumination of 20 ft-C. In a later development, still considerable improvement in picture quality has been obtained and a resolution of 180 lines/inch has been reached. it is concluded that the stage has been reached where the fabrication of larger modules and modularized panels could be undertaken. Author (TAB)

N69-14979*# Case Western Reserve Univ., Cleveland, Ohio.
A LUNAR GRAVITY SIMULATOR, VOLUME 2
Richard J. Morgen Washington NASA Dec. 1968 142 p refs
(Contract NAS1-7459)
(NASA-CR-1234) Avail: CFSTI CSCL 14B

The design of a vertical lunar gravity simulator is presented. The simulation technique involves negating the various limb segments separately using constant-force negator springs. Overhead support is provided by magnetic air pads which offer negligible resistance to horizontal movement. The torso harness that is used provides for six degrees of freedom over a wide range of movements. The dynamic behavior of the lunar gravity simulator is considered. Indications are that low fatigue-life negator coils mounted back-to-back will be suitable as constant-force, long-deflection springs. A conical drum, adjustable-force negator unit is optimized for minimum weight. A technique for determing the mass and center of mass of the various body segments is also presented. An analysis to determine the correct attachment points for negating the limbs and torso is presented. It is recommended that negator coils of the lowest rated fatigue life be used as constant-force, long-deflection spring elements. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N69-13907 Purdue Univ., Lafayette, Ind.
LOW CONVERSION RADIOLYSIS OF METHANE CONTAINING TRACES OF OXYGEN AND OLEFINS
Dale Carter Myers (Ph.D. Thesis) 1967 160 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-6336

A study was made of the effects of traces of oxygen (<0.1 vol%) on the low conversion radiolysis of methane, and of methane containing traces of olefins (≈0.1 vol%). Oxygen is consumed at a rate which is linear with absorbed dose. The minimum dose (ev/molecule) necessary for complete oxygen removal is: $D \approx [O_2] \times 1.3 \times 10^{-6}$, where $[O_2]$ is in ppm. The protection, by oxygen, of ethylene and acetylene formed during radiolysis allows the determination of $G(C_2H_4) = 0.624 \pm .021$ and $G(C_2H_2) = 0.045-0.060$. Oxygen, when present in concentrations as low as 10 to 20 ppm, completely stops the formation of hydrocarbons via radical reactions. Under these conditions, ethene is formed by a methylene insertion reaction with methane ($G(C_2H_6) = 0.276 \pm .02$) and hydrogen is formed by a series of ion molecule reactions ($G(H_2) = 2.73 \pm .06$). Dissert. Abstr.

N69-13909 Pittsburgh Univ., Pa.
HYDROGEN BOND STUDIES USING SOLUTION CALORIMETRY
Murty S. S. R. Tanikella (Ph.D. Thesis) 1967 248 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.20 Order No. 68-7505

Hydrogen bond enthalpies (ΔH_f's) were determined in dilute carbon tetrachloride solutions by solution calorimetry using IR and F^{19} NMR equilibrium constants (K_f's). A novel approach for accurate measurement of hydrogen bond enthalpies is developed by using the base as solvent. This pure base method is independent of equilibrium constants. The application of the method to many systems and its limitations are discussed in detail. Drago's procedure for simultaneous determination of ΔH_f and K_f is applied to three bases using phenol and *para*-fluorophenol as proton donors. A method for determinating accurate ΔH_f and K_f values entirely by calorimetry is presented. Solvent and temperature effects on ΔH_f are discussed. Using ΔH_f's and measured $\Delta\nu$ values, the validity and limitations of Badger-Bauer-Drago rule is discussed. Dissert. Abstr.

N69-13961 University of Southern Calif., Los Angeles.
ELECTRIC FIELD INDUCED SPECTRA OF PROPYNAL AND OTHER MOLECULES
Roddy Merl Conrad (Ph.D. Thesis) 1966 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-7176

Electric field induced spectra have been obtained by applying an A.C. electric field to molecules in the gas phase and photo-electrically detecting the change in electronic absorption coefficient caused by the field. A lock-in amplifier tuned to the first overtone of the field frequency was used. The apparatus for recording electric field spectra is described in detail. Two approaches to the theory of electric field induced spectra are presented. Electric field induced spectra of propynal are used to measure the electric dipole moment component along the near symmetric top axis of the $^1A''$ excited state of propynal to be .99 ± .2 D. The use of electric field induced spectra for assignment of the absorption spectrum of propynal is demonstrated over a range of experimental conditions. Electric field induced spectra of carbon disulphide, sulphur dioxide, pyridazine, pyridine, pyrimidine, aniline, and thiophosgene are also reported and discussed. Dissert. Abstr.

N69-13970 Maryland Univ., College Park.
A COMPARISON OF CONDUCTANCE EQUATIONS FOR SYMMETRICAL ELECTROLYTES
David William Ebdon (Ph.D. Thesis) 1967 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-7016

The interionic attraction theory of conductance was investigated to determine which of the existing extended conductance equations best describes the variation with concentration of the equivalent conductance of unassociated symmetrical electrolytes. Computer programs were written to test various equations to determine which was the most internally consistent and to what extent the distance of closest approach parameter affected the association constant. It was concluded that the Fouss-Onsager equation was the most internally consistent equation. However, the physical significance of the distance parameter was called into question. It was further concluded that equations attempting to graft short-range interactions onto a continuum theory have highly erroneous results. For associated electrolytes it was determined that only the functional form of the conductance equation was important. Therefore it was proposed that conductance data for associated electrolytes be fitted using the standard three parameter conductance equation, with activity coefficients calculated by a truncated Davies equation in order to avoid introducing an ion size parameter. Dissert. Abstr.

N69-13974# Oak Ridge National Lab., Tenn.
STANDARD GAMMA-RAY SPECTRA OF THE ELEMENTS FOLLOWING 14-MeV NEUTRON IRRADIATIONS
J. E. Strain *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 48-55 refs Supported by AEC (See N69-13971 04-24)
Avail: CFSTI

This lecture will deal with the problems of identification of gamma-ray emitting nuclides produced by 14-MeV neutron bombardment and the acquisition of standard gamma-ray spectra. The discussion will include such factors as flux measurements, sample transport, counting geometry, beta interference and precision. The usefulness of the standard spectra will be demonstrated in the prediction of non-destructive analysis sensitivities and matrix interferences. Author

N69-13975# Kaman Nuclear, Colorado Springs, Colo.
PROBLEMS IN PRECISION ACTIVATION ANALYSIS WITH FAST NEUTRONS
D. E. Wood *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 56-81 refs (See N69-13971 04-24)
Avail: CFSTI

Activation analysis with fast neutrons from accelerators requires careful techniques to achieve high precision since the neutron flux from a small source of neutrons varies rapidly with distance from the source. Problems and methods in flux monitoring, positioning, timing, and statistics will be discussed in relation to the overall precision available from the analysis. Special methods for obtaining uniform irradiation throughout a sample volume will be considered for application to heterogeneous samples. Preparation of adequate standards is necessary to provide accuracy as well as precision. This problem has been studied for a small range of variables, although no general solution is available for analysis of all elements in all matrices. Author

N69-14015 Ohio State Univ., Columbus.
MECHANISM STUDIES ON SOME THERMAL AND PHOTOCHEMICAL REACTIONS
Roger Mac Layton (Ph.D. Thesis) 1967 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3012

4 Trichloromethyl 2, 4, 5 trimethyl 2, 5 cyclohexadienone(I) was resolved by a new method using optically active α (isopropylideneaminooxy) propionic acid to form the diastereoisomers of α (4 trichloromethyl 2, 4, 5 trimethyl 2, 5 cyclohexadienylideneaminooxy) propionic acid which were hydrolyzed with levulinic acid to the enantiomers of (I). Stereoisomers of 1, 4 Diphenyl 3, 4 epoxy 1 butanone V were prepared and irradiated. Prolonged irradiation of V afforded only recovered starting material V whereas the irradiation of *trans* 1, 4 diphenyl 3, 4 epoxy 1 butanone gave rise to photoproducts after several hours. The lack of reactivity in V was attributed to the fact that the γ hydrogen atom is geometrically incapable of abstraction by the excited carbonyl chromophore. Dissert. Abstr.

N69-14016 Brown Univ., Providence, R. I.
POLARIZED CRYSTAL SPECTRA OF TRANSITION METAL HYDRATES
Ian Munro Walker (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-1511

Large single crystals of guanidine aluminum sulfate hexahydrate and aluminum chloride hexahydrate containing varying amounts of the trivalent iron series ions were grown. Measurement of the polarized spectra over a wide temperature range (20-300°K) yielded information on the nature of the noncubic distortions which the transition metal ion undergoes. The spectrum of vanadium(III) was interpreted assuming that the ground-state is singly degenerate in a trigonal field. The first excited state is unsplit due to the Jahn-Teller effect, while the second shows a large splitting. The spectrum of chromium(III) is fitted to the two parameter scheme, that of manganese(III) to a level scheme having a large trigonal and small tetragonal potential; and cobalt(III) is analysed using a scheme similar to that employed for chromium(III). The spectrum of titanium(III) in both lattices shows a large tetragonal splitting of the excited state, due to the influence of the Jahn-Teller effect. The influence of hydrogen bonding on the observed spectra is discussed. The dependence of the crystal field on concentration is considered, and the lattice forces operating on the hydrated ions is compared with those operating on ions in refractory lattices. Dissert. Abstr.

N69-14017 Michigan State Univ., East Lansing.
THE DEPOLARIZATION OF RAYLEIGH SCATTERED LIGHT
Robert James Anderson (Ph.D. Thesis) 1967 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-4097

The depolarization ratio for vertically polarized light and its temperature dependence were measured in pure liquids, binary solutions, and polymer solutions using a helium-neon laser as the light source, a phase sensitive detection system, and a photometer designed to take advantage of the laser output. The results are considered to be the most accurate available, since the methods used have removed the sources of most of the difficulties previously encountered in these measurements. The results indicate that the depolarization ratio of vertically polarized light has a temperature dependence somewhere between linear and logarithmic. The theory is found to agree well with the experimental results in the case of polar molecules, while for non-polar molecules agreement is poor for those species with a high degree of symmetry. These results have been interpreted as indicating that the hyperpolarizabilities play a significant role in determining the depolarization by pure liquids. In binary solutions, it is found that the results agree well with theory at intermediate compositions, even when the two pure components do not. Dissert. Abstr.

N69-14019 Florida State Univ., Tallahassee.
CONCERNING THE EFFECTS OF ENVIRONMENT ON THE ELECTRONIC SPECTRA OF SOME RARE EARTH IONS
David Eugene Henrie (Ph.D. Thesis) 1967 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-2918

The nature of the interactions between a rare earth ion and its environment is studied both theoretically and experimentally. The results indicate that the environmental factor most important in producing modifications in the spectra at and above room temperature is "covalency" as measured by the nephelauxetic effect. While the magnitude of covalent effects is small with respect to the energy levels of the ion, inclusion of these effects is apparently necessary to explain the behavior of the parameters obtained from the "Judd-Oefelt Theory" dealing with the oscillator strengths of *f-f* transitions. It is suggested that covalent enhancement of a vibronic mechanism will explain the phenomenon of "hypersensitivity." The use of intensity changes as an indication of the symmetry of a rare earth complex is also discussed, and the conclusion is reached that such variations more realistically indicate the degree of "covalency" rather than symmetry. It was also shown that inclusion of covalent effects (with respect to their effect on the energy levels of the f^N configuration) requires little modification of the configuration interaction approach for "spherical ions," the modification being in the interpretation of the parameters. Dissert. Abstr.

N69-14034# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PREPARATION AND PROPERTIES OF TANTALUM DISULFIDE
V. F. Bukhanevich et al 15 Dec. 1967 7 p refs Transl. into ENGLISH from Ukr. Khim. Zh., v. 32, no. 9, 1966 p 926-929 (AD-677229; FTD-HT-23-1120-67) Avail: CFSTI CSCL 7/2

Preparation and properties of tantalum disulfide were studied to supplement literature data on sulfides of refractory transition metals. Direct reaction of the powdered metal with hydrogen sulfide was selected as the method of preparation most adaptable to industrial processes and susceptible to yield single-phase tantalum sulfides. Stoichiometric tantalum disulfide in powdered form was obtained by reacting at 1400C, 99.0% tantalum metal with hydrogen sulfide which was prepared in situ from hydrogen and sulfur vapors. The lattice parameters and picnometric density of the product were found to be in agreement with literature data and

with the calculated value, respectively. The TaS2 product was found to be stable in boiling water and HCl but decomposed completely by heating in oxidizing reagents, e.g., concentrated H2SO4, HNO3, H2O2. TaS2 was resistant to oxidation in an oxygen stream up to 300C. In oxygen at 500C, TaS2 was completely oxidized to tantalum pentoxide and sulfur dioxide. Author (TAB)

N69-14037# Bhabha Atomic Research Centre, Bombay (India).
THE MECHANISM OF SEPARATION OF NIOBIUM AND TANTALUM BY CHLORINATION OF THEIR MIXED OXIDES BY CARBONMONOXIDE AND CHLORINE
K. R. Srinivasan and P. K. Jena 1968 11 p refs
(BARC-329) Avail: CFSTI

In this piece of work, an attempt has been made to get an insight into the mechanism of preferential chlorination and hence the separation of niobium from tantalum by chlorination of their mixed oxides with CO & Cl_2. In addition to the kinetic studies on the reaction between $TaCl_5$ and Nb_2O_5 undertaken in this paper, the results of our earlier studies on the kinetics of chlorination of pure pentoxides of Nb and Ta by CO and Cl_2 have also been taken into consideration. From these data, it has been concluded that inspite of the fact that the chlorination of Nb_2O_5 requires a higher activation energy (E = 7.8 K.Cal./mole) than that of Ta_2O_5 (E = 5.1 K.Cal./mole), the comparatively fast reaction between $TaCl_5$ and Nb_2O_5 (E = 1.91 K.Cal./mole) in the following manner 5 $TaCl_5$ + 2Nb_2O_5 = 2$NbCl_5$ + 2 $NbOCl_3$ + 3 $TaOCl_3$ + Ta_2O_5 is the cause of the preferential chlorination of Nb_2O_5. Author

N69-14038# Bhabha Atomic Research Centre, Bombay (India).
DIFFUSION OF Fe^{59} IN Fe–Cr ALLOYS
S. P. Ray and B. D. Sharma 1968 17 p refs
(BARC-332) Avail: CFSTI

Self-diffusion in Fe-Cr alloys has been investigated by diffusing Fe^{59} isotope in both para- and ferromagnetic temperature ranges. It is found that ln D vs. 1/T diffusivity plots exhibit a deviation from an Arrhenius relationship around the Curie temperature. For any alloy composition the activation energy for diffusion in paramagnetic range is found to be smaller than in farromagnetic range. Further, this difference in activation energy values, ΔQ, decreases with increasing chromium content of the alloy. The present studies show that in the Fe-Cr system, ΔQ can be correlated with the Curie temperature by an equation. Author

N69-14040# Bhabha Atomic Research Centre, Bombay (India).
ANALYSIS OF GASES IN METALS THE D-C ARC GAS CHROMATOGRAPHIC TECHNIQUE. PART 1: DETERMINATION OF OXYGEN AND NITROGEN IN METALS USING HELIUM AS THE INERT GAS MEDIUM
A. P. D. 'Silva, P. K. Wahi, and S. S. Biswas 1968 14 p refs
(BARC-336-Pt-1) Avail: CFSTI

The adoption of the d-c. arc gas chromatographic technique for the determination of oxygen and nitrogen in metals, using helium as the inert gas medium, and a thermal conductivity detector is described. This method has been applied for a number of metals like copper, steel, zirconium and thorium. A precision of 5% in the range 50 to 500 p.p.m., both for oxygen and nitrogen has been obtained. Author

N69-14044 Duke Univ., Durham, N. C.
A STUDY OF TRANSITIONS IN He^4 AND He^3
David Leslie Elwell (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-3423

We have studied the molar volume and isothermal expansion coefficients of He^4 in the range 1.25 to 4.2°K and 0.5 to 28 atm, with particular emphasis on the region near the λ-line, and we have begun a similar study of He^3 in a region near the critical point. To do this we have measured the resonant frequency of a tunnel diode oscillator, the capacitor of which contained the helium sample. These frequency measurements determined the dielectric constant of the sample, and we have used the Clausius-Mossotti relation to calculate the molar volume from this. The agreement of our molar volume results with the results of previous workers indicates that the molar polarizability is indeed a constant for both He^4 and He^3 in the regions where we have studied them. The expansion coefficients were obtained from the molar volume results by graphical differentiation. The measurements were made at constant pressures which were known to 0.05 atm, or better and which were held constant to ±0.05 mm of Hg. Dissert. Abstr.

N69-14049 Rensselaer Polytechnic Inst., Troy, N. Y.
THERMAL MASS TRANSPORT AND ELECTROMIGRATION IN BETA-ZIRCONIUM
David Richard Campbell (Ph.D. Thesis) 1967 195 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-817

The migration velocities of zirconium ions in a thermal gradient and an electric potential gradient were determined by a marker technique. Large grained, high purity wires were resistively heated with dc in a vacuum of 2×10^{-8} torr and the subsequent motions of transverse razor scratches were recorded at selected intervals of time. The temperature dependence of electromigration was determined from 1500 to 1750°C. The ions migrated toward the cathode with a pseudo-activation energy of 31 k cal/mole. If this process is dominated by the "low temperature mechanism" then the effective charge, Z^*e, is approximately temperature independent and is given by (27)e. Dissert. Abstr.

N69-14050# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDIES OF TRIVALENT RARE-EARTH OXIDE-BERYLLIUM OXIDE SYSTEMS
Han Weng-Loong 25 Oct. 1967 6 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 9, 1965 p 831–832
(AD-677250; FTD-HT-23-1086-67) Avail: CFSTI CSCL 7/4

Experiments were conducted on products of reactions between trivalent rare earth oxides and beryllium oxides and on the equilibrium of the Gd2O3-BeO system. Phase diagrams of the Gd2O3-BeO system were plotted based on the analytic results obtained by three methods, viz., quenching, polarizing microscope, and x-ray diffraction. A new biaxial crystalline phase (n sub p = 1.89, n sub g = 1.94, angle between axes = 90 deg.) was found having parameters a = 3.803 plus or minus 0.003 A, b = 9.85 plus or minus 0.03 A c = 10.51 plus or minus 0.02 A. The new crystalline phase shows a diffraction pattern similar to that of yttrium oxide when being decomposed at 1480C. Chemical composition of the new phase was determined to be Gd2O3.2BeO. Author (TAB)

N69-14055# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
THE MICRO-DETERMINATION OF CARBON, HYDROGEN, AND NITROGEN IN ORGANIC AND ORGANOMETALLIC COMPOUNDS
R. H. Gaddy Sep. 1968 12 p refs
(Contract AT(07-2)-1)
(DP-1150) Avail: CFSTI

Carbon, hydrogen, and nitrogen in a variety of unusual organic and organometallic compounds were determined accurately and precisely with a commercial instrument consisting of a high-temperature combustion furnace coupled with a gas chromatograph and equipped for automatic operation. Author (NSA)

N69-14071*# Techtran Corp., Glen Burnie, Md.
A NEW ANALYSIS OF MOLECULE DIMENSIONS [EINE NEUE BESTIMMUNG DER MOLEKULDIMENSIONEN]
A. Einstein. Washington NASA 18 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 19, 1906 p 289–306
(Contract NASw-1695)
(NASA-TT-F-12005) Avail: CFSTI CSCL 07D

It is shown that the size of the molecules of a substance dissolved in an undissociated dilute solution can be determined from the internal friction of the solution in the solvent and diffusion of the dissolved substance in the solvent, providing the molecular volume of the dissolved substance is greater than that of the solvent. This is done by applying hydrodynamic equations to the solvent, considering the liquid is homogeneous and therefore without molecular structure. Author

N69-14121# Japan Atomic Energy Research Inst., Takasaki. Div. of Research.
A STUDY ON RADIATION CATALYTIC CHEMISTRY: IRRADIATION EFFECT ON ACTIVE CARBON CATALYSTS
Shoichi Sato Dec. 1967 35 p refs In JAPANESE; ENGLISH summary
(JAERI-1155) Avail: CFSTI

The application of radiation energy has been developed gradually in many fields. In order to use the energy of radiation more efficiently, the need has arisen for further study of the catalytic processes. Studies were made on the effects of radiation on materials, especially solids, and also on the effects of radiation in phenomena relating to catalysis. Kinetic studies of catalytic phosgene synthesis over active carbons and of the effects of gamma radiation on the kinetic constants are described. The compensation effect in kinetic factors appeared on irradiation and a marked change in catalytic activity was observed with the dose of 10^8 R. The catalysts were examined by elementary analysis, ESR absorption and ir spectroscopy, and the results are considered on the basis of the catalytic effects. The catalytic sites are reasonably related to the 2-dimensional structure of carbons, and carbons with highly-grown network structure are thought to have high sensitivity to radiation. Author (NSA)

N69-14139 California Univ., Berkeley.
MAGNETIC RESONANCE SPECTRA OF VCl_4 AND OTHER PARAMAGNETIC SPECIES
David Wixon Pratt (Ph.D. Thesis) 1967 265 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.45 Order No. 68-139

Techniques for performing electron spin resonance studies of paramagnetic species in glasses or polycrystalline matrices at temperatures below the λ-point of liquid helium were developed and the experimental procedures described in detail. These methods were applied in the investigation of the transition metal compounds VCl_4 and $V(CO)_6$. The ESR spectrum of VCl_4 at liquid helium temperatures were studied in the pure compound and in solvents. The relaxation times for the unpaired electron in VCl_4 were measured over a wide temperature range using a variety of techniques, including pulse experiments. ^{35}Cl NMR experiments were performed on pure VCl_4 and solutions of VCl_4 in $TiCl_4$ at room temperature and above. The ESR spectrum of $V(CO)_6$ at liquid helium temperatures was observed in the pure material and in benzene and n-heptane glasses. Radicals produced by the chemical and electrolytic reduction of S_4N_4 and S_4N_3Cl were studied by ESR and the spin Hamiltonian parameters obtained. Dissert. Abstr.

N69-14173# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
BAND STRUCTURE AND THE TITANIUM $L_{II, III}$ X-RAY EMISSION AND ABSORPTION SPECTRA FROM PURE METAL, OXIDES, NITRIDE, CARBIDE AND BORIDE Technical Summary Report, May 1967–May 1968
David W. Fischer and William L. Baun Aug. 1968 90 p refs
(AD-677588; AFML-TR-68-161) Avail: CFSTI CSCL 7/4

The titanium L sub II,III X-ray emission and absorption spectra (wavelength approximately 27.5 A) from pure metal, oxides, nitride, carbide and boride have been investigated using a plane crystal vacuum spectrometer with electron beam excitation and flow-proportional counter detection. Emission spectra were studied over a wide range of accelerating voltages and takeoff angles showing that satellite emission and self-absorption effects can significantly distort the band shapes and energy positions of intensity maxima. A replica of the L sub II,III absorption spectrum can be constructed solely from emission spectra afflicted with widely different amounts of self-absorption. The first two absorption maxima appear to reflect the crystal field splitting of the Ti 3d levels into d epsilon and d gamma bands. The L sub II,III emission spectra from the oxides, nitride and carbide exhibit an important cross-over transition from the 2p level of the anion to the L sub II and L sub III levels of titanium. Author (TAB)

N69-14180*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF THE RESULTS OF A ROUND ROBIN ANALYSIS FOR OXYGEN IN POTASSIUM AND SODIUM
Glenn R. Zellars and Charles A. Barrett Washington Dec. 1968 39 p refs
(NASA-TN-D-4971) Avail: CFSTI CSCL 07D

Analysts from 17 laboratories analyzed tube samples of high-purity potassium and sodium for oxygen. Most oxygen analyses were determined by the mercury amalgamation method and several by vacuum distillation; one value of oxygen in potassium was obtained by neutron activation analysis. Analytical results submitted by the participating laboratories gave a mean value for oxygen in potassium of 14.7 ppm with a standard deviation of 5.08 ppm. For dodium, the mean value was 10.7 ppm with a standard deviation of 4.70. The oxygen results for each alkali metal showed variations significantly in excess of the experimental error. Statistical techniques were applied to the oxygen data to identify the most likely sources of variability. Author

N69-14183 Lehigh Univ., Bethlehem, Pa.
A STUDY OF THE RELATIONSHIP OF ATOM MOVEMENTS, WETTABILITY AND ADHESION IN THE GLASS-METAL OXIDE-METAL SYSTEMS
Thomas Nilan Fogarty (Ph.D. Thesis) 1967 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-4883

The relationship between wettability, atom movements and adhesion in the glass-metal oxide-metal system has been investigated by the measurement of contact angles, electron probe analysis of the transition zone and by mechanical adhesion testing. Several glasses composed of ions with different polarizability joined to the oxidized iron-nickel-cobalt alloy ("Kovar") and oxidized chromized "Kovar" were studied. There was no correlation between thermodynamic adhesion (as measured by contact angles) and mechanical adhesion if different metal oxide substrates were considered. For example, borosilicate glass on chromized "Kovar" specimens exhibited a high contact angle minimum thermodynamic adhesion but these were the strongest seals mechanically tested. Even though contact angles did not change appreciably with time at temperature, inhomogeneity in the sessile drop indicates that these glass-metal oxide-metal systems were not in true equilibrium. Dissert. Abstr.

N69-14189# California Univ., Santa Barbara. Dept. of Chemistry.
FLUORESCENCE SPECTRA IN FROZEN HEPTANE AT HIGH PRESSURES
David E. Hein and Henry Offen 1 Nov. 1968 17 p refs Submitted for publication
(Contract N00014-67-A-0120-0001)
(AD-677475; TR-15) Avail: CFSTI CSCL 7/4

The fluorescence spectra of coronene and 1,12-benzoperylene have been studied in frozen heptane as a function of pressure (0-30 kbar). The fluorescence red shifts at 77 deg. K are 5 inverse cm/kbar and 8.3 inverse cm/kbar, respectively. Author (TAB)

N69-14197# DuPont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
DETERMINATION OF MERCURY IN RADIOACTIVE SAMPLES BY FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY
J. Allen Wheat Aug. 1968 10 p refs
(Contract AT(07-2)-1)
(DP-1164) Avail: CFSTI

A flameless atomic absorption technique was adapted for determination of mercury in highly radioactive samples. Mercury is isolated on a small copper coil by spontaneous displacement from acid solution and is then vaporized by resistance heating in an evacuated cell in the light path of an atomic absorption spectrophotometer. The mass of mercury vapor is determined by attenuation of characteristic mercury radiation. Concentrations of mercury as low as 10^{-5}M in solutions containing as much as 10^{12} d/(min) (ml) of alpha activity and 10^{12} c/(min) (ml) of beta-gamma activity were determined with precisions of about 5%. The method was used successfully to trace the path of mercury in plant processes and to determine the concentration of mercury in plant product. Author (NSA)

N69-14198 Tennessee Univ., Knoxville.
A STUDY OF THE ISOMER SHIFTS IN THE MOESSBAUER SPECTRA OF Fe 57 DISSOLVED IN 4d AND 5d TRANSITION METALS
Palmer Norman Peters (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-3761

The charge density at the iron nucleus has been determined from the Mössbauer effect isomer shift for ^{57}Fe dissolved in 4d- and 5d-transition metals and some of their binary alloys. Data from other sources are included to provide values for most of the isomer shifts for the 3d-, 4d-, and 5d-transition metals and for copper, silver, and gold. The data are analyzed under certain assumptions using an extension of the theory of the screening of the iron impurity atom by means of metallic type conduction electrons and by localized d-state electrons on the iron atom. Effects on the isomer shift due to the volume per atom of the host, the host lattice distortion caused by the iron impurity, and the d-state configuration of the iron atom are accounted for in the theory. Dissert. Abstr.

N69-14201 Wisconsin Univ., Madison.
THE VIBRATIONAL SPECTRA OF SOME COMPOUNDS OF SULFUR AND NITROGEN
Joseph Bragin (Ph.D. Thesis) 1967 212 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-16898

Investigations of the vibrational spectra of S_2N_2 and S_4N_4 have been carried out with particular emphasis on the longwave infrared between 250 and 50 cm^{-1}. A spectrometer was designed and used to obtain the far infrared spectra of the two sulfur nitrides. Both molecules were subjected to an analysis of their normal modes and their vibrational spectra assigned on the basis of the results. A review of previous work in the far infrared and a discussion of the design parameters of a far infrared spectrometer are presented. Details of the construction and unique features of the present instrument are discussed and the performance of the instrument is evaluated. A normal coordinate computer program was developed and details of the mathematics which are of interest to investigators who would use this program are presented in an appendix. Dissert. Abstr.

N69-14202# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
CHEMICAL STUDIES OF KURCHATOVIUM ELEMENT 104. 3. CHEMICAL DEVICE IN THE CYCLOTRON BEAM
Yu. T. Chuburkov, I. Zvara, and B. V. Shilov 1968 30 p refs in RUSSIAN
(JINR-P7-4021) Avail: CFSTI

Design and operation of chemical instruments installed in the intrinsic cyclotron beam for multicharged ions are described. Physico-chemical conditions used in the studies of chemical properties of Kurchatovium (element 104) ($T_{1/2}$ = 0.3 sec) are discussed. Author (NSA)

N69-14219# Mound Lab., Miamisburg, Ohio.
STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION Research Report, Jan.–Mar. 1968
30 Sep. 1968 45 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1495) Avail: CFSTI

Progress is reported on separation methods for C, He, Ne, Ar, Kr, and Xe isotopes; on thermal-diffusion research; and on low-temperature research. NSA

N69-14228# California Inst. of Tech., Pasadena.
STUDIES IN CHEMICAL DYNAMICS AND RADIATION CHEMISTRY Technical Progress Report, 1 Jul. 1967–30 Jun. 1968
Aron Kuppermann 6 Sep. 1968 54 p refs
(Contract AT(04-3)-532)
(CALT-532-37) Avail: CFSTI

Research progress is reported on diffusion kinetics, low-energy electron scattering, photoelectron spectrometry, elementary reactions by photolysis at variable wavelength, reactions in crossed molecular beams, and theory of chemical reactions. NSA

N69-14236# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Nuclear and Radiation Physics Section.
A PROPOSED EXPERIMENT TO MEASURE THE DENSITY PROFILE OF HYDROGEN AS A FUNCTION OF DEPTH AT THE SURFACE OF A SOLID
Gerald M. Pedower Nov. 1968 16 p ref
(RM-431) Avail: Issuing Activity

A new technique employing the well-known $Li^7(p, \gamma)Be^8$ capture-gamma resonance at 0.44 MeV is proposed as a means for measuring the depth profile of hydrogen in solids. In essence, the method requires simply that the lithium nucleus and the hydrogen nucleus (proton) be interchanged in their customary roles of target and projectile, respectively. This could be of special usefulness in studies of the critical problem of hydrogen embrittlement in metals. Author

N69-14242*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REDEPOSITION OF VACUUM OUTGASSED PRODUCTS
Carolyn S. Griner 20 Nov. 1968 42 p refs
(NASA-TM-X-53801) Avail: CFSTI CSCL 07D

A quartz crystal microbalance (QCM) with a sensitivity of 10^{-9} gm/cm^2 is used to determine the quantity of material redeposited from an outgassing material source in a vacuum environment. The vacuum system was designed for the QCM and materials testing and is free of organic background. Results of tests on 18 materials are presented in terms of film thickness as a function of temperature to 150°C. Both metallic and non-metallic materials were tested. Author

N69-14258 Stanford Univ., Calif.
SELF DIFFUSION IN CADMIUM SELENIDE AND CADMIUM TELLURIDE
Paul Michael Borsenberger (Ph.D. Thesis) 1967 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-6392

The high temperature defect equilibria in CdSe and CdTe has been investigated by measuring the radiotracer self diffusion coefficients of Cd^{109} in CdSe and Cd^{109} and Te^{123} in CdTe. The self diffusion measurements were performed as functions of temperature, component partial pressure, and added impurity content. Profiles of the radiotracer concentration versus distance were determined by sectioning and counting techniques. Self diffusion coefficients were determined by fitting the non-replenished source solution of the diffusion equation to the radiotracer concentration profile. It is concluded that the self diffusion of Cd occurs by either the motion of isolated ionized Cd vacancy acceptors and interstitial Cd donors, or by the motion of a bound Frenkel (Cd vacancy–Cd interstitial) pair. The self diffusion of Te has been interpreted on the basis of a neutral Te interstitial defect. Dissert. Abstr.

N69-14259# Bureau of Mines, Boulder City, Colo. Metallurgy Research Lab.
ELECTROWINNING ALUMINUM FROM ALUMINUM CHLORIDE. OPERATION OF A TWO-COMPARTMENT CELL
E. L. Singleton, D. E. Kirby, and T. A. Sullivan Dec. 1968 19 p refs
(BM-RI-7212) Avail: Issuing Activity

The electrochemical reduction of aluminum chloride to aluminum was investigated in a closed, two-compartment cell utilizing a molten chloride electrolyte. The externally heated cell was divided into a reduction compartment and a combination $AlCl_3$ feed and metal removal compartment. Aluminum was deposited at 700° C on a molten aluminum cathode from a KCl–NaCl–$AlCl_3$ electrolyte. The $AlCl_3$ content of the electrolyte was replenished by either vapor or solid additions. The chlorine evolved was collected and measured to give a quantitative evaluation of $AlCl_3$ reduction. The effects of anode and cathode current densities and $AlCl_3$ concentration on anode current efficiences were studied. A range of 64 to 84 percent anode current efficiency was obtained with the 25-pound electrolyte capacity cell and related auxiliary equipment. Author

N69-14266# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
EMISSION SPECTRA OF MOLECULAR GASES EXCITED BY 10 keV ELECTRONS
Dietmar E. Rothe and David J. McCee Dec. 1968 70 p refs
(CAL-165) Avail: Issuing Activity

A systematic investigation was made of the spectra of N_2, NO, O_2, H_2O, H_2, CO, and CO_2, excited by a 10 keV electron beam of 100 microamperes current, in the wavelength range between 2800 Å and 6600 Å. The observed spectra are presented along with the identifications of observed emission lines and bands. For certain band systems of N_2^+, O_2^+, CO^+, CO, and CO_2^+ the variation of intensity with pressure was also measured over the pressure range of 10 to 100 microns Hg. Possible mechanisms associated with this pressure dependence are given where intensity does not vary linearly with pressure. A preliminary study was made of the effects caused by the presence of other gases on the beam-excited emission of N_2^+. Theoretical arguments are presented to show that, for the gases considered, the only important cross-excitation mechanisms are excitation by secondary electrons and quenching by inelastic collisions. Investigations performed in binary mixtures with nitrogen indicate no significant quenching of the N_2^+ radiation by O_2, H_2O, H_2, and CO at total gas pressures below 100 microns Hg. Some quenching is observed for N_2–CO_2 mixtures and the pressure dependence of this effect is presented. Author

N69-14279# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Aerodynamic Research Dept.
A 2EV ARGON BEAM: SCATTERING AT A SOLID SURFACE AND OBSERVATIONS OF RADIATION ACCOMPANYING THE BEAM
G. T. Skinner Mar. 1968 11 p refs Presented at the 6th Intern. Symp. on Rarified Gas Dyn., Boston, Jul. 1968
(Contract AF 49(638)-1490)
(AD-677580; AFOSR-68-2354) Avail: CFSTI CSCL 7/4

Results are presented showing what appears to be a transient behaviour in the scattering of a 2.14 eV argon beam from a glass target with an adsorbed gas layer. Approximately 10 to the 15th power atoms per sq. cm. strike the surface during the experiment. Results are also presented showing ultraviolet radiation emanating from the nozzle source of the beam. Author (TAB)

N69-14308# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
DISPOSAL OF FLUORINE
James D. Navratil 29 Aug. 1968 10 p refs
(Contract AT(29-1)-1106)
(RFP-1200) Avail: CFSTI

A literature review of fluorine disposal systems is presented. Experimental work on fluorine disposal at Rocky Flats is also presented. Alumina, soda lime, and charcoal were evaluated as fluorine disposal media. Plugging of the disposal traps occurred regularly when alumina and soda lime were used. The use of charcoal reduced plugging problems, but a check valve was required to eliminate interference from small pressure surges resulting from the charcoal-fluorine reaction. In a given size trap, charcoal had twice the fluorine capacity for fluorine disposal, as compared to soda lime or alumina capacity. Author (NSA)

N69-14338*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
THERMALLY INSENSITIVE DETERMINATIONS OF TRANSITION PROBABILITIES FOR CI, OI, NeI, AlII, SiI, SiII, PI, PII, SI, SII, AND CII
Myron Howard Miller (Ph.D. Thesis) May 1968 339 p refs
(Grant NsG-359)
(NASA-CR-98593; BN-580) Avail: CFSTI CSCL 07D

Absolute transition probabilities were measured for more than 150 lines in the visible spectra of CI, OI, NeI, AlII, SiI, SiII, PI, PII, SI, SII and CII. Stark shifts and widths were measured for 16 neutral lines or blended multiplets, and widths alone were determined for 27 ion lines. The thermodynamic state of the shock tube plasma was deduced from redundant data. Temperature was simultaneously measured four independent ways. Absolute pressures were recorded with calibrated quartz transducers and compared with those predicted from measured shock speeds and real-gas thermodynamics. The majority of our A-values agree with Coulomb approximations to within 30%. Results for 4s-4p transitions in SiII, PI and SI are factors of 2–8 smaller than predicted by Coulomb approximations. Marked departures from LS coupling are observed in the spectra of SiI, PII and SII. Stark broadening of neutral lines generally agrees with theory to better than 10%; while some ion lines agree with current theories to within 30%, others disagree by factors as large as 8. Author

N69-14339*# Techtran Corp., Glen Burnie, Md.
THE COMPOSITION OF THE SESQUICHLOROHYDRATE OF HYDROCYANIC ACID AND ITS SYNTHETIC APPLICATION [UEBER DIE CONSTITUTION DES SESQUICHLORHYDRATES DER BLAUSAURE UND DESSEN SYNTHETISCHE VERWENDUNG]
L. Gattermann et al. Washington NASA Dec. 1968 6 p ref Transl. into ENGLISH from Chem. Ber. (Weinheim), v. 31, 1898 p 1770–1774
(Contract NASw-1695)
(NASA-TT-F-12025) Avail: CFSTI CSCL 07C

Benzene was used in aldehyde synthesis with hydrocyanic acid. The reaction product was poured onto ice, forming a solid which, when boiled with alcoholic potash, produced benzhydrylamine. The sesquichlorohydrate was produced exactly according to Claisen's specifications. The progress of the reaction is described. Toluene results in a much more active reaction than benzene. Dimethylaniline was also employed, yielding the leuco-base. Author

N69-14402# RAI Research Corp., Long Island City, N. Y.
DEVELOPMENT OF MACROMOLECULAR SUPERCONDUCTORS Final Report, Nov. 8, 1966–Jan. 7, 1968
Richard H. Wiley, Joseph Lee, John Raffo, and Victor Chen 22 Mar. 1968 56 p refs
(Contract DAAK02-67-C-0122)
(AD-677513; RAI-391) Avail: CFSTI CSCL 7/3

Synthesis of macromolecules suitable for testing of the validity of Littles theory of superconductivity of organic molecules has been attempted. The synthesis consists of polymerization of acetylenic derivatives into polyenes with suitable substituents. Polymerizations were done under inert or vacuum atmosphere with solid state, and solution state, gamma radiation initiation, and with highly stereospecific co-ordination catalysts. It was found that the catalyst initiated polymers have a higher molecular weight than gamma radiation initiated polymers. However, the molecular weights in both cases are very low. The polymerized products have been fabricated into testing form, and subjected to mutual inductance measurements as a function of temperature. Time does not allow a full evaluation of the validity of this test method for superconductivity, and additional work is required. Author (TAB)

N69-14406# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS AND CONVERSIONS OF CERTAIN p-DERIVATIVES AND p,p'-DERIVATIVES OF DIPHENYLOXIDE
M. G. Rudendo et al 31 Oct 1967 14 p refs Transl. into ENGLISH from Neftekhimiya (Moscow), v. 5, no. 2, 1965 p 256–263
(AD-677021; FTD-HT-23-712-67) Avail: CFSTI CSCL 11/8

As part of an investigation of highly stable oils and their components, a number of derivatives of diphenyl ether were prepared and their properties tested. All of the derivatives made were either monofunctional para-derivatives or difunctional di-para-derivatives. The initial reaction in either case was chloromethylation. The chloromethylated products were converted to aldehydes by the Sommelet reaction. The corresponding alcohols and acids were obtained from the aldehydes by the Canizzaro reaction. The aldehydes were converted into p-phenoxycinnamic acid and the corresponding dibasic acid by both the Claisen condensation, and the Perkin reaction. The starting chloromethylated derivatives were also converted to alkoxymethyl, acetoxymethyl, hydroxymethyl, and carboxy derivatives of diphenyl ether. The diethyl, diisobytyl, and di-2-ethylhexyl ethers of p,p-dihydroxy methyldiphenyl ether fit the boiling point, solidification point, and viscosity requirements for synthetic lubricating oils. Thermooxidative stability studies showed that at 150C, 1 mole of p,p-diisobutoxy methyldiphenyl ether absorbed 0.167 mole of oxygen, as compared to 0.8 mole of oxygen absorbed by 1 mole of dioctyl sebacate under the same conditions. Author (TAB)

N69-14433# Mound Lab., Miamisburg, Ohio.
COLORIMETRIC DETERMINATION OF ZIRCONIUM IN THE PRESENCE OF PLUTONIUM AND URANIUM WITH ALIZARIN RED-S
C. T. Bishop, W. G. Yates, P. L. Redding, and D. E. Sellers 24 Sep. 1968 9 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1542) Avail: CFSTI

Zirconium can be determined colorimetrically in the presence of plutonium and uranium by the formation of a zirconium–alizarin red-S complex, which absorbs at 525 mμ. The acid concentration of solutions taken for analysis must be greater than 2M to prevent hydrolysis of zirconium, but the solution in which the zirconium alizarin red-S complex is formed must be 0.15 to 0.25M due to a decrease of absorbance at higher acid concentrations. Up to 6 mg of plutonium and even greater amounts of uranium (200 mg) per 25 ml of solution may be present provided mercaptoacetic acid is added to reduce the plutonium to the tripositive oxidation state. Although the colorimetric determination of zirconium in the presence of plutonium and uranium is not as precise as other qualitative techniques, the method is readily adaptable to radioactive glovebox operations. Author (NSA)

N69-14446# Argonne National Lab., Ill.
METHOD FOR THE PREPARATION OF NEPTUNIUM IN THE 7-VALENT STATE [METODY POLUCHENIYA NEPTUNIYA V SEMIVALENTNOM SOSTOYANII]
V. I. Spitsyn et al Sep. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 181, 1968 p 128–130
(ANL-TRANS-670) Avail: CFSTI

The possibility of obtaining Np^{7+} without using ozone was investigated. Reactions of Np^{6+} with XeO_3 gave Np^{7+} very rapidly, while reactions with perxenonate ions gave Np^{7+} much more slowly. Reactions of neptuantes with alkaline solutions of $K_2S_2O_8$ also gave Np^{7+} ions. Perborates could not be used in the preparation of these ions because of the formation of the reducing agent H_2O_2. Reactions with periodates and bismuthates gave Np^{7+} ions as did hypochlorite and hypobromite ions and bromine. NSA

N69-14470# Utah Univ., Salt Lake City. Coll. of Engineering.
RECRYSTALLIZATION AND SINTERING OF OXIDES Technical Progress Report, 1 Sep. 1967–31 Aug. 1968
Ivan B. Cutler Oct. 1968 7 p
(Contract AT(11-1)-1122)
(COO-1122-14; UTEC-68-068) Avail: CFSTI

Five abstracts are presented on research performed. Effect of particle shape on the kinetics of sintering of glass, the effect of water vapor on the sintering of glass powder compacts, sintering of glass powders during constant rates of heating, and determination of an effective viscosity of powders as a function of temperature are listed. Progress on the interdiffusion studies of transition metal oxides in MgO is reported. NSA

N69-14516# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
A VERSATILE SPECTROGRAPHIC METHOD FOR THE ANALYSIS OF A WIDE RANGE OF MATERIALS
M. S. W. Webb and M. L. Wardingham Jun. 1968 27 p refs
(AERE-R-5799) Avail: CFSTI

The development of a sensitive and versatile spectrographic method for the analysis of a wide range of small samples (1.5 mg) is described. The sample is mixed with a buffer consisting of a mixture of lithium fluoride and graphite and burnt in a dc arc with anode excitation. Cobalt is used as an internal standard. Sensitivities corresponding to a sample weight of 1.5 mg vary according to impurity element from 1 to 100 ppM. Coefficients of variation for single exposures at the 100 ppM level of between 5 and 10% were obtained for many elements. Author (NSA)

N69-14521 Iowa State Univ. of Science and Technology, Ames.
NEUTRON ACTIVATION ANALYSIS FOR IRIDIUM, PALLADIUM AND SILVER IN PLATINUM
Leodegario de Gracia Cilindro (Ph.D. Thesis) 1967 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-2809

A sensitive procedure for the simultaneous determination of trace amounts of iridium, palladium and silver in a platinum stock by thermal neutron activation analysis utilizing gamma-ray spectrometry was developed. The radiochemical separation scheme involved selective elution of the chloro complexes of the elements of interest through a strongly basic anion exchange resin column, followed by further decontamination methods. The activities of 14-hour Pd^{109}, 74-day Ir^{192} and 253-day Ag^{110m} were monitored by accumulation of counts in a 400-channel pulse height analyzer using a 3" diameter NaI(Tl) crystal detector. Corrections for counting geometry, coincidence counting losses, background, radioactive decay and chemical yields were considered. Average impurity contents of 15 ± 2.1 ppb of iridium in 12 analyses, 28 ± 4.3 ppb of palladium in 8 analyses and 2.4 ± 0.27 ppm of silver in 6 analyses, were obtained for the platinum stock investigated. Dissert. Abstr.

N69-14522 Indiana Univ., Bloomington.
CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF ANODICALLY FORMED GOLD OXIDE
Henry Perry Longerich (Ph.D. Thesis) 1967 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-2321

An investigation of the chemical and physical properties of electrochemically formed gold has been performed. When a gold electrode is anodized at a very high current-density (200 milliamperes/cm^2), a solid oxide forms which flakes off the electrode. This oxide was analyzed for gold(I) by a potentiometric titration with permanganate, and it was found that a negligible percentage of the gold in this oxide is gold(I). Based upon the assumption that gold oxide consists entirely of gold(III), a moderately thick oxide film was stripped from an oxidized gold electrode with hydrochloric acid and analyzed for gold, the results suggesting $Au_2O_3 \cdot 5/2\ H_2O$ as the formula for gold oxide. Qualitative studies of the thermal stability of flaked gold oxide were made at several temperatures and pressures, and it was discovered that the oxide decomposed at 100°C in a high vacuum or at 300°C at atmosphere pressure. Dissert. Abstr.

N69-14523 Pennsylvania State Univ., University Park.
NONBRIDGING LIGAND EFFECTS OF SOME ELECTRON TRANSFER REACTIONS OF CHROMIUM(III) COMPLEXES WITH CHROMIUM(II)
David Eugene Pennington (Ph.D. Thesis) 1967 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-3555

The rates of electron transfer reactions which proceed *via* inner-sphere mechanisms are often substantially effected by the nature of the nonbridging ligands. The present investigation was designed to evaluate the importance of such effects in the chromium(II)-catalyzed equations of *cis*- and *trans*-$Cr(en)_2XCl^{n+}$ ($X = Cl^-, H_2O$). These equations proceed by electron transfer *via* chloride-bridged transition states. In addition to the nonbridging ligand effects of groups bound to the oxidant, a second class of such effects has been observed, namely specific ion effects. The $Cr(OH_2)_5I^{2+}-Cr^{2+}$ reaction is particularly sensitive to the presence of added fluoride, chloride, and bromide ions. Not only is the rate of disappearance of $Cr(OH_2)_5I^{2+}$ greatly enhanced, but the iodide ion is also quantitatively substituted by the added halide ion. Dissert. Abstr.

N69-14533# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Chemical Physics.
PRESSURE SHIFTS OF INFRARED LINES, LOW-TEMPERATURE SPECTRA OF MOLECULES, AND TECHNIQUES OF INTERFERENCE SPECTROSCOPY Final Scientific Reprt, 1 Jan. 1965–31 Dec. 1967
Joseph H. Jaffe, Salo Kimel, and Abraham Ben-Reuven May 1968 24 p refs
(Contract AF 61(052)-838)
(AD-677005; AFCRL-68-0490) Avail: CFSTI CSCL 7/4

A summary is given of experimental and theoretical studies in the following subjects: Pressure-induced shifting and broadening of rotation and vibration-rotation spectra, and the study of intermolecular forces; low-temperature spectroscopy of polar impurities in non-polar crystals with application to lattice dynamics and intermolecular forces; analysis of noise and errors in Fourier-transform spectroscopy; refraction spectrum of individual vibration-rotation lines in the near infrared; general theory of collision broadening of spectral lines. Author (TAB)

N69-14536# National Inst. for Metallurgy, Johannesburg (South Africa).
DETERMINATION OF SELENIUM AND TELLURIUM IN SILVER CHLORIDE AND URANIUM COMPOUNDS
Elaine A. Jones, B. G. Russell, and T. W. Steele 26 Oct. 1967 9 p ref
(NIM-244) Avail: Issuing Activity

After dissolving the sample, Se and Te are separated by precipitation in strongly alkaline solution with Ag_2O as a collector for the Te. The Se passes into the filtrate and is separated from interfering substances by precipitation with $Al(OH)_3$ as a collector. The Se is then determined spectrophotometrically with 3,3'-diaminobenzidine after extraction into toluene. The Te is separated from interfering substances by coprecipitation with $Fe(OH)_3$ and elution through a cation exchange resin. It is determined spectrophotometrically with sym-diphenylthiourea. NSA

N69-14543# Argonne National Lab., Ill.
STUDY OF THE PENETRATION OF AEROSOLS INTO FILTER BEDS [ETUDE DE LA PENETRATION DES AEROSOLS DANS LES COUCHES FILTRANTES]
Hassan Parnianpour (Ph.D. Thesis—Paris Univ., 1967) Aug. 1968 52 p refs Transl. into ENGLISH from CEA Rept. CEA-R-3347
(ANL-TRANS-646) Avail: CFSTI

A radioactive aerosol is used to study the penetration of particles inside various filtering media by a layer technique. The penetration of the active thoron deposit fixed on the atmospheric dust was examined for a series of filters which were considered to be representative of the various filtering materials used. From this series of tests it appears that the penetration of an ultrafine aerosol in a filter made up of fibrous matter involves two different processes: the first part of the curve characterizes the surface effect; the second part, which is practically exponential in form, has a slope that depends on the test conditions and on the nature of the filter. The changes in the penetration as a function either of the porosity or of the rate of filtration yield only a qualitative check of the theory; in all cases the penetration is much greater than predicted. Author (NSA)

N69-14548 Cornell Univ., Ithaca, N. Y.
STUDIES OF THE PHASE DIAGRAM OF He 3 He 4 LIQUID MIXTURES BELOW 1° K
Erlend Haakon Graf (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-4665

The phase diagram of He^3-He^4 liquid mixtures has been investigated in the region near the limit of He^3 solubility and near the consolute point. Data on the phase separation curve for low He^3 concentrations (6.6 to 8.5 mole-%) are obtained by a nuclear resonance technique in which formation of the He^3-rich phase is detected by a small (1% of the sample volume) coil located in the top of the chamber. The results indicate the limit of He^3 solubility at absolute zero to be below 6.6 mole-%. The phase separation curve near the consolute point has been determined by a dielectric constant measurement. Two small capacitors, each comprising about 1.5% of the sample volume are used to monitor the dielectric constant of each of the liquid phases, from which the density and He^3 concentration can be deduced. The high and low concentration branches of the phase separation curve approach each other linearly and appear to intersect at an angle, forming a sharp peak. Dissert. Abstr.

N69-14578 Fordham Univ., New York.
CHEMICAL REACTIONS IN A CORONA DISCHARGE
Maurice W. Ranney (Ph.D. Thesis) 1967 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-3703

The irradiation of benzene in a corona discharge reactor has been studied in detail. Maximum conversions were obtained using a helium carrier gas to transport benzene through the corona zone at flow rates of 3–4 gm./hr. and 15 kv potential. Under these conditions, the conversion to identifiable products (exclusive of acetylene) was 11.4% and the major products were a benzene soluble polymer 8.5%, a benzene insoluble polymer 0.8%, biphenyl 0.8% and phenyl, benzyl cyclopentenes 0.9%. Present in small proportion were o-, m-, and p-terphenyl, 1,3- and 1,4-cyclohexadiene, fulvene and cyclohexene. The high conversion of benzene to polymeric products is of particular interest in view of the stability of the benzene nucleus towards conventional low energy initiators. Polymers which are soluble in benzene and chloroform comprise 70–80 per cent of the product yield depending on experimental conditions. All polymeric products were shown to be structurally similar and the benzene soluble polymer was fractionated to yield material ranging from a yellow tacky resin (M.W. 300) to a high melting yellow solid (M.W. 4500). Dissert. Abstr.

N69-14577 Rutgers Univ., New Brunswick, N. J.
THE EFFECT OF ADDITIONS ON THE UPPER TRANSITION TEMPERATURES OF $BaTiO_3$
Ronald Staut (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-4556

$BaTiO_3$ has phase transitions from rhombohedral to orthorhombic to tetragonal to cubic at −90°C, 10°C, and 120°C which are accompanied by changes in electrical properties. The 10°C transition is within the temperature range of interest, and is accompanied by an increase in dielectric constant of 500 in going from the orthorhombic to the tetragonal configuration. A compositional study was chosen to shift the orthorhombic to tetragonal transition to lower temperatures, and thereby increase the thermal stability. One mole percent lanthanide additions were made to $BaTiO_3$. All additions decreased the temperature of the orthorhombic to tetragonal transition and caused shifts in the Curie temperature, with successive smaller ionic sized additions down to Tm^{+3} increasing the Curie temperature. No positive temperature coefficient of resistivity anomaly was observed for any of these 1 m. % additions. Photomicrographs of these compositions showed substantial amounts of boundary material which was different from bulk grains. Hydrostatic pressure on upper transitions of $BaTiO_3$ caused shifts in both transitions to lower temperatures. Dissert. Abstr.

N69-14584*# Scripta Technica, Inc., Washington, D. C.
ACTION OF FORMALDEHYDE ON GLYCINE AND ITS METALLIC SALTS [UEBER DIE EINWIRKUNG VON FORMALDEHYD AUF GLYKOKOLL UND GIYKOKOLL-METALLSALZE]
H. Krause NASA Dec. 1968 16 p refs Transl. into ENGLISH from Chem. Ber. (Weinheim/Bergstr.), v. 51, 1918 p 136–150
(Contract NASw-1694)
(NASA-TT-F-11981) Avail: CFSTI CSCL 07C

Reaction of formaldehyde with glycine gives β-hydroxytrimethyleneglycine: $C_7H_{14}O_5N_2$. Some of the properties and reactions of this product, as well as of its salts, were investigated. Author

N69-14608*# Swift and Co., Chicago, Ill. Research and Development Center.
ADVANCED BLADDER TECHNOLOGY. GAS IMPERMEABLE PROTEIN FILMS AND LAMINATES Final Report
Thomas H. Donnelly [1968] 86 p
(Contract NAS7-487)
(NASA-CR-98632) Avail: CFSTI CSCL 07D

Protein films of various thicknesses were made from gelatins, plasticizers, crosslinking agents, reinforcing fibers, and water. A comprehensive evaluation for gas permeability was made using hydrogen, helium, oxygen, nitrogen, and carbon dioxide. Tensile breaking strengths were also determined of the various film compositions. The data were statistically analyzed. From the experiments performed it was concluded that desirable degrees of impermeability were obtained with gelatin films. However, none of the chemical modifications described led to any significant improvements in the cryogenic flexibility of these films. B.P.

N69-14610 Syracuse Univ., N. Y.
SOME COMPLEXES OF NICKEL (II) WITH OXYGEN AND SULFUR CONTAINING LIGANDS
Joseph Terence Morrison (Ph.D. Thesis) 1967 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-7073

Complexes of nickel (II) with four different ligands bonding through oxygen and/or sulfur were prepared. The ligands all form five membered chelate rings in bonding to the metal. The four ligands used are, the acid anions: oxalate, $C_2O_4^{2-}$, dithiooxalate, $C_2O_2S_2^{2-}$, thiodiglycolate, $(C_2H_2O_2)_2S^{2-}$ and thioglycolate, $C_2H_2O_2S^{2-}$. The following ligands or combinations of ligands were found to form solids involving six coordinate, octahedral nickel(II) complexes: oxalate, oxalate and thioglycolate, thiodiglycolate and thioglycolate. Four coordinate square planar complexes were formed by dithiooxalate ion, dithiooxalate ion and thioglycolate ion and, in solution only, thioglycolate ion. The thioglycolate-nickel system actually gave several different products, of varying ligand to metal ratio. Some of the complexes formed apparently crystalize with water also coordinated to the metal ion. Dissert. Abstr.

N69-14611 California Univ., Riverside.
DIELECTRIC FUNCTION OF A MODEL INSULATOR
John L. Fry (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-4924

The wave number and frequency dependent dielectric function, $\epsilon(q,\omega)$ has been calculated for a model insulator using the random phase approximation. The model insulator consists of a free electron conduction band represented by a single OPW, and a valence band

represented by linear combinations of ionic wave functions. All energy bands are assumed parabolic and isotropic. Numerical results are obtained for Ar, KCl, CsCl, MnS, and Si, in reasonable agreement with previous calculations. Screened impurity potentials are obtained for KCl, CsCl, and MnS using the numerical results. Screened exchange potentials have been obtained by using an interpolation formula, and evaluated for the chlorine ion in CsCl. Dissert. Abstr.

N69-14614 Vanderbilt Univ., Nashville, Tenn.
THE INFRARED AND RAMAN SPECTRA, NORMAL COORDINATE ANALYSIS, BARRIER TO INTERNAL ROTATION, AND THERMODYNAMIC PROPERTIES OF TRIFLUOROMETHYL HYPOFLUORITE
Paxton Marshall Wilt, Jr. (Ph.D. Thesis) 1967 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-5427

The purpose of the research reported in this thesis is to obtain the infrared and Raman spectra of trifluoromethyl hypofluorite (CF_3OF), complete with Raman polarization data and accurate infrared band contours. The infrared spectrum of gaseous CF_3OF from 500–33 cm^{-1} is obtained in this study. These data are interpreted satisfactorily on the basis of the expected C_s symmetry which predicts the twelve observed fundamental absorption bands. Eight of the twelve fundamentals are observed in the Raman spectrum of the liquid at −105°C; polarization data are determined for the four strongest Raman lines and are used in interpreting the vibrational spectra. Dissert. Abstr.

N69-14615 Washington Univ., St. Louis, Mo.
ULTRASONIC PARAMAGNETIC RESONANCE IN MAGNESIUM OXIDE-FERROUS ION
Robert Glenn Leisure (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-5143

Ultrasonic paramagnetic resonance was used to study the interaction between Fe^{++} ions in MgO and longitudinal ultrasonic waves. Both absorption and dispersion signals were observed. The measurements were carried out between 4.2 and 26° K at a frequency of 1.1 GHz. A cw ultrasonic spectrometer, analogous to a conventional EPR spectrometer, was assembled. Thin film CdS transducers were used to permit efficient generation and detection of ultrasound. The thin film transducers, eliminating the need for bonds, permitted quantitative measurements to be made. Magnetic field dependent attenuation and velocity fractional changes as small as 10^{-6} and 10^{-9} respectively were detectable. Temperature dependent velocity fractional changes as small as 10^{-6} were detectable. Working equations were derived which relate the small changes in attenuation and velocity to easily measured quantities. Dissert. Abstr.

N69-14617 California Univ., Riverside.
THEORETICAL AND EXPERIMENTAL STUDIES OF BAND DISPERSION PHENOMENA IN GAS CHROMATOGRAPHY
Garrard Lee Hargrove (Ph.D. Thesis) 1967 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-4957

A series of studies have been made of band dispersion phenomena in gas chromatography. One of the important parameters required for such studies is the gas phase interdiffusion coefficient of a test vapor in the carrier gases to be used. A chromatographic method for evaluating this quantity is described which is applicable over the complete range of temperatures used in gas chromatography. Using this method the gas phase interdiffusion coefficients of six vapors in two carrier gases have been measured over the temperature range 25–200° C. Dissert. Abstr.

N69-14628 Pittsburgh Univ., Pa.
AMALGAM COULOMETRY AT CONSTANT CURRENT
James Robert Wells (Ph.D. Thesis) 1967 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-4452

The current efficiencies for electrogeneration of the following metal ion species from liquid amalgam anodes are reported: Cd(II), 99.8%; Bi(III), 99.8%; In(III), 101%; Co(II), 101%; Ni(II), 101%. The reproducibility was ±0.3% or better in all cases. The supporting electrolyte was 0.1M sodium perchlorate except for nickel where 0.1M potassium thiocyanate was used. The results obtained indicate that generation of the species studied should be applicable to coulometric titrations. Current densities from 1 to 40 ma. per sq. cm. were used without any decay in current efficiency although an increase in apparent current efficiency was noted for generation of In(III) at low current densities. During the course of this investigation a phenomenon was noted at the glass frit which isolated the amalgam anode from the platinum cathode. At high currents (0.05–0.2 ampere) gas evolution and light emission occurred at this frit. This effect was attributed to boiling of the solution in the frit and glow-discharge electrolysis through the resulting vapor phase. Dissert. Abstr.

N69-14632# Shell Chemical Co., Union, N. J.
STRAIN-CHAIN ALCOHOL PLASTICIZERS IN ELECTRICAL APPLICATIONS
R. C. Breitel, R. W. Hemwall, and Carl Amond (Freeport Kaolin Co., Gordon, Ga.) 5 Dec. 1968 6 p Presented at 17th Intern. Wire and Cable Symp., Atlantic City, N. J., 4–6 Dec. 1968 Prepared in Cooperation with Freeport Kaolin Co.
(AD-677596) Avail: CFSTI CSCL 9/1

Phthalate plasticizers based on straight-chain alcohols have gained wide acceptance in poly (vinyl chloride) (PVC) compounding in recent years, because in contrast to the branched-chain plasticizers, i.e. dioctyl phthalate (DOP) and diisodecyl phthalate (DIDP), they possess superior low-temperature flexibility and lower volatility. The efficiency of the straight-chain phthalate is also better than that of the branched-chain counterparts. To meet the increasing demand for straight-chain plasticizers new straight-chain alcohol facilities are now on-stream. The intent of this paper is to show how the straight-chain phthalates can be effectively used in electrical PVC compounds. Author (TAB)

N69-14644# Boeing Scientific Research Labs., Seattle, Wash. Polymer Lab.
THERMALLY STABLE POLYMER PRECURSORS. DIISOPROPENYL AND BIS(1-PHENYLVINYL) p-PHENYLENE OXIDE MONOMERS
Roy G. Neville and Robert W. Rosser Oct. 1968 15 p refs
(AD-677111; D1-82-0763) Avail: CFSTI CSCL 7/3

The syntheses of a homologous series of p-disubstituted isopropenyl and 1-phenylvinyl monomers derived from phenyl ether, 1,4-diphenoxybenzene and bis(4-phenoxyphenyl) ether are reported. Infrared spectral data for the diolefins and their precursors are presented, together with preliminary information on the polymerization of these novel monomers to thermally-stable and oxidation-resistant polymers. Author (TAB)

N69-14649# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
REACTIONS URANIUM TETRAFLUORIDE-CHLORINE MONOFLUORIDE, URANIUM MONOFLUORIDE-CHLORINE TRIFLUORIDE, URANIUM PENTAFLUORIDE-CHLORINE FLUORIDE, URANIUM PENTAFLUORIDE-CHLORINE TRIFLUORIDE
Michel Luce, Raymond Benoit, and Olivier Hartmannshenn Jun. 1968 59 p in FRENCH

(CEA-R-3558) Avail: Issuing Activity

The reaction between ClF_3 and UF_4 is partially explained by the study of the reactions of the three systems: UF_4–ClF, UF_5–ClF, and UF_5–ClF_3. The analytical techniques used were: microsublimation, infrared spectroscopy, and thermogravimetry. The origin of the by-products is indicated. Author (NSA)

N69-14652*# Techtran Corp., Glen Burnie, Md.
THE CORRELATION BETWEEN THE MOLECULAR STRUCTURE OF POLYVINYL CHLORIDE AND ITS COMBUSTION PRODUCTS
Sugio Otani et al. Washington NASA Jan. 1969 14 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 65, no. 10 p 1617–1622
(Contract NASw-1695)
(NASA-TT-F-12029) Avail: CFSTI CSCL 07D

A thermogravimetric analysis of polyvinyl chloride was made as a means of studying the correlation between the molecular structure of polyvinyl chloride and the structure of its combustion products. In addition, the infrared and ultraviolet spectra of the combustion products formed by heating of polyvinyl chloride to 425°C were observed. The polyvinyl chloride samples used were Geon 103 EP (G) and a sample polymerized at −30°C (F). As a result of these tests, the following facts were determined. The average molecular weight of the combustion products was 700–800, these products having a condensed ring aromatic structure and comprising a considerable quantity of compounds with a saturated aliphatic structure. It was also found that the combustion products of sample G contained a higher proportion of compounds with longer aliphatic structures than those derived from sample F. Sample F had a greater tendency to form linear condensed ring aromatic structured products than did sample G. Author

N69-14656 California Univ., Berkeley.
CYCLOTRON RESONANCE EXPERIMENTS IN LEAD
George Rodger Gathers (Ph.D. Thesis) 1967 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-5722

Cyclotron resonance experiments in lead are described. Evidence is given indicating a new mechanism which produces an apparent doubling of the effective mass for orbits on the cylindrical arms of the third zone electron surface with the magnetic field tipped at large angles with respect to the sample surface. General aspects of the theory of cyclotron resonance in metals and the experimental and theoretical band structure of lead are discussed at length. New sample preparation methods for obtaining large strain free high purity single crystals of lead are described. A computer program is developed for automated data reduction of cyclotron resonance impedance derivative curves containing resonance corresponding to multiple masses. Dissert. Abstr.

N69-14671# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
A MEASUREMENT OF THE DISSOCIATION RATE CONSTANT OF IODINE MOLECULES
Goro Kamimoto, Hiroyuki Matsui, and Tomohisa Akiyama Oct. 1967 22 p refs
(CP-13) Avail: CFSTI

The rate of dissociation of iodine molecules was measured at high temperature using the chemical shock tube. The experiments were done by making use of iodine vapor diluted with nitrogen. In the course of these measurements, the rate of recombination reaction in which the third body is I_2 itself, was determined. Results were compared with the reaction rate obtained by making use of Eyring's semiempirical method. The agreement between their temperature dependence is fairly good. Author

N69-14683# Commissariat a l'Energie Atomique, Saclay (France).
FINAL PURIFICATION OF STRONTIUM BY PRECIPITATION [PURIFICATION FINALE DU STRONTIUM PAR PRECIPITATION]
Ch. Aubertin Oct. 1968 21 p refs In FRENCH
(Contract EURATOM-025-62-10-RISF)
(EUR-4076f) Avail: CFSTI

The main subject in question is magnesium-strontium separation in the final phase of a strontium 90 recovery process. The impurity composition in the strontium to be purified is the same as might be expected with the extraction process using di-2-ethyl-hexyl-phosphoric acid. Magnesium-strontium separation has been attempted by precipitation of the oxalates, carbonates, oxinates and hydroxides, the last-named giving the best results. It is therefore possible to reduce from 100 to 1 the magnesium-strontium mole ratio with a loss equal to or less than 1%. This purification directly precedes the preparation of strontium titanate. Author

N69-14685# Commissariat a l'Energie Atomique, Saclay (France).
RECOVERY OF CAESIUM 137 USING A MINERAL ION-EXCHANGER [RECUPERATION DU CAESIUM 137 A L'AIDE D'UN EXCHANGEUR D'ION MINERAL]
J. Prosperi, J. Lefevre, and A. Raggenbass Oct. 1968 25 p In FRENCH
(Contract EURATOM-025-62-10-RISF)
(EUR-4075f) Avail: CFSTI

The development of a mineral ion-exchanger consisting of a combination of zirconium phosphate and ammonium phosphotungstate has become necessary owing to the high acidity (HNO_3 about 2 M) of the fission-products solutions from which we were trying to recover caesium 137. Although incomplete as yet, our knowledge of this exchanger suggests that it could conceivably be produced on a semi-industrial scale. The first experiments at this level tally well with the Laboratory results, and enable about 200 Ci of cesium 137 to be recovered per kilogram of exchanger material. Elution is obtained by ammonium acetate 5M, which is then eliminated by heating in an evaporator until it forms a dry precipitate. The caesium is then recovered by water and can be converted into chloride or incorporated in the form of a pollucite-type silico-aluminate. Author

N69-14697# Atomic Energy Commission Research Establishment, Riso (Denmark).
STUDIES ON SULFONIC ANHYDRIDES
N. Hesselbjerg Christensen (Ph.D. Thesis, Denmark Univ.) Apr. 1968 110 p refs
(RISO-169) Avail: CFSTI

Some problems connected with the preparation of labelled compounds of high specific activity are discussed, and it is shown that the formation of sulfonic anhydride in aromatic sulfonation can be used in a very simple way for the preparation of ^{35}S-labeled p-iodobenzenesulfonic anhydride. The applicability of labelled sulfonic anhydrides as reagents in the double isotope derivative analysis is indicated. A review is included on the kinetics and mechanism of aromatic sulfonation, the formation of sulfonic anhydrides in sulfonation reactions, and the sulfonylating reactions of sulfonic anhydrides. As a special case of sulfonylation, the hydrolysis of some sulfonic anhydrides was studied kinetically, and various methods of determining the molecularity of a solvolytic reaction are discussed. The kinetic solvent isotope effect was also measured for the hydrolysis of sulfonic anhydrides in aqueous acetone and dioxan. Author

N69-14702 Oregon State Univ., Corvallis.
ANALYTICAL UTILIZATION OF HAFNIUM AND ZIRCONIUM BOROHYDRIDES
Ronald Edward Walsh, Jr. (Ph.D. Thesis) 1968 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-6014

The borohydrides are the most volatile known compounds of hafnium and zirconium and consequently have potential analytical utility. The determination of hafnium and zirconium in the presence of each other has long been a difficult assignment and there are a limited number of good analytical methods. The borohydrides are reviewed and a study made of their analytical utility. Apparatus has been devised to prepare and store the metal borohydrides. Conventional thermal electron bombardment mass spectrometry is not satisfactory for zirconium borohydride because of the compounds' thermal instability. Zr^+, ZrH^+, and various doubly charged species in the m/e 60–70 region have been found. Apparatus and methods are developed for the analytical hydrolysis of the metal borohydrides and their mixtures. Dissert. Abstr.

N69-14704# Los Alamos Scientific Lab., N. Mex.
DETERMINATION OF THE SOLUBILITY OF OXYGEN IN SODIUM BY VACUUM DISTILLATION
V. J. Rutkauskas 15 Jul. 1968 12 p refs
(Contract W-7405-ENG-36)
(LA-3879) Avail: CFSTI

The solubility of O_2 in Na was determined over the range 125 to 300°C by vacuum distillation. The temperature range was covered in increments of 10 to 25°C with a minimum of three separate determinations at each temperature level. A least-squares fit of the experimental data yielded a correlating equation of $\log_{10} y = 4.25 - 3499/T$, where y = wt % O_2. The expression gives a value for ΔH of 16,000 cal-mole^{-1}. The reproducibility of results obtained at each of the equilibrium temperature conditions was excellent, with an apparent standard deviation of 0.5 ppm in the O_2 concentration range of 1 to 10 ppm and 5% above 10 ppm. The internal consistency of the solubility results is better than that of previously published data, and the values are considerably less in the low temperature range than those shown on other solubility curves. Author (NSA)

N69-14705# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.
POLY-AS-TRIAZINES
Paul M. Hergenrother Aug. 1968 24 p refs
(AD-677545; D1-82-0748) Avail: CFSTI CSCL 7/3

Two high molecular weight (η(inh) > 1.0) soluble poly-as-triazines have been prepared by the solution polycondensation in m-cresol of 2,6-pyridinediyl dihydrazidine with p,p-oxybis(phenyleneglyoxal) hydrate) and with p,p-oxydibenzil. Thermal characterization of the poly-as-triazines by TGA showed polymer decomposition temperatures of approx. 400 deg. C after a 300 deg. C cure in argon. Poly-as-triazines exhibited weight losses <8% after aging in static air at 316 deg. C for 200 hours. Clear yellow films cast from m-cresol solutions exhibited good flexibility and toughness even after aging at 316 deg. C for 200 hours in air and after refluxing in 10% aqueous potassium hydroxide solution for 24 hours. Author (TAB)

N69-14710# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung.
THE REACTION RATIO OF URANIUM MONOMONITRIDE WITH METAL OXIDES [DAS REAKTIONSVERHALTEN VON URANMONONITRID MIT METALLOXIDEN]
H. Kleykamp, P. Korogiannakis, C. Politis, F. Thuemmler, and H. Wedemeyer May 1968 66 p refs In GERMAN; ENGLISH summary
(KEK-771) Avail: CFSTI

Specimens containing 30 vol % UN and 70 vol % metal oxide were annealed together in high vacuum (at about 10^{-5} torr) at 600 and 1,100°C for 10 and 25 hours, respectively. With few exceptions, the annealing processes were accompanied by reactions resulting in the oxidation of UN to form UO_2 and by a reduction of the metal oxides. The reduction products which could be identified, were free metals, metal nitrides, and in some cases metal oxides with less oxygen content. U_2N_3 was formed as a by-product in the conversion with MgO and γ-Al_2O_3. While the reactions were low at 600° C, considerable conversions could in most cases be observed for annealings at 1,100° C. The individual reaction products were determined by X-rays with goniometer pictures. Because of their high vapor pressures the free metals of the light metals (Mg,Al) could partly be found as distillates in the cooler regions of the reaction tube. NSA

N69-14736 California Univ., Riverside.
ELECTROCHEMICAL STUDIES OF ORGANIC COMPOUNDS DISSOLVED IN CARBON PASTE ELECTRODES. 2: ELECTROCHEMICAL STUDIES AT THE CONDUCTING GLASS ELECTRODE. 3: ELECTROCHEMICAL STUDIES OF MOLYBDENUM-ETHYLENEDIAMINE-TETRAACETIC ACID COMPLEXES
Franklin Alfred Schyltz (Ph.D. Thesis) 1967 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-4951

Chronopotentiometric oxidation of ferrocene shows that mass transfer of species from the carbon paste electrode is diffusion-controlled. The chronopotentiometric transition time also is a function of the viscosity of the pasting liquid and the ratio of graphite (carbon) to liquid. Using a conducting glass electrode incorporated in a spectrophotometric cell, chronopotentiometric and chronoamperometric studies show that simultaneous optical and electrochemical measurements can be quantitatively related. In the oxidation of *o*-tolidine, spectral monitoring demonstrates the presence of a chemical reaction between the reduced and oxidized species leading to a free radical. From potentiostatic relaxation experiments, the formation constant of *o*-tolidine free radical is calculated to be 5×10^2 in pH 4 acetate buffer; for the rate of free radical formation, a value of 7×10^3 liters mole^{-1} sec^{-1} is obtained. Using coulometry, chronopotentiometry, and cyclic voltammetry, the electrochemistry was investigated with the intention of establishing a correlation between the electrochemical results and the unique structural features of the chelates. Dissert. Abstr.

N69-14741# Weizmann Inst. of Science, Rehoveth (Israel). Dept. of Chemical Physics.
THE MEANING OF COLLISION BROADENING OF SPECTRAL LINES. 1: THE CLASSICAL-OSCILLATOR
Abraham Ben-Reuven May 1968 55 p refs
(Contract AF 61(052)-838)
(AD-677002; AFCRL-68-0489; SR-9) Avail: CFSTI CSCL 7/4

Following the analogy between the Liouville-space formulation of spectral line shape theory and the classical theory of damped harmonic oscillators, the latter theory is reformulated and used in a simple derivation and interpretation of various results of line shape theory. Models are worked out for such cases as impact broadening, the transition from resonant to non-resonant line shape by momentum-inverting collisions, the narrowing by collisions of the Doppler width, statistical broadening, and resonance broadening owing to collisions of similar molecules. Author (TAB)

N69-14755# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
CRITICALITY PARAMETERS AFFECTING EQUIPMENT DESIGN FOR FLUORIDE VOLATILITY PROCESS
Donald R. Ferguson and C. Lee Schuske 29 Aug. 1968 6 p
(Contract AT(29-1)-1106)
(RFP-1208) Avail: CFSTI

Various criticality parameters which may have an important influence on the design of fluoride volatility processing equipment are discussed. The data presented may not have direct application to the design of a specific piece of process equipment. However by optimizing the various parameters discussed, in light of process requirements, the designer may provide a basis for a specific model. Author (NSA)

N69-14756# National Research Council of Canada, Ottawa (Ontario).
NEGATIVE IONS FROM ALKALI HALIDES AND ELECTRON AFFINITIES OF ALKALI METALS AND ALKALI HALIDES [NEGATIVE IONEN AUS ALKALIHALOGENIDEN UND ELEKTRONENAFFINITAETEN DER ALKALIMETALLE UND ALKALIHALOGENIDE]
H. Ebinghaus [1968] 10 p refs Transl. into ENGLISH from Z. Naturforsch. (Tuebingen), no. 19a, 1964 p 727–732
(NRC-TT-1316) Avail: Issuing Activity

The formation of negative ions from alkali metal halide vapors by electron resonance capture was investigated by mass spectrometry. The ions found, of the form M^-, X^-, MX^-, and M_2X^- (M = Li, Na, K, Rb, Cs; X = F, Cl, Br, I) could be said, on the basis of the energetics and relative intensities, to originate from monomeric and dimeric molecules. From the measured appearance potentials and known dissociation energies, lower limits were established for the electron affinities of the alkali metals. These are in the vicintiy of 0.5 eV. For some alkali metal halides, they are about 1.2 eV. In the case of the alkali metals, presumably these values are the actual electron affinities. The experiments with positive ions show that dimeric and trimeric molecules, as well as monomeric ones, are present in alkali halide vapours, so that negative ions might also be expected from these polymers. The measurements were restricted to resonance captures, i.e., to electron energies of less than 10 eV. Author (NSA)

N69-14770# Royal Aircraft Establishment, Farnborough (England.)
A STUDY OF PERFLUOROALKYL AND PERFLUOROALKYLENE 1,2,4 AND 1,3,4 OXADIAZOLES
J. P. Critchley and J. S. Pippett Feb. 1968 62 p refs
(RAE-TR-68026) Avail: CFSTI

5 perfluoroalkyl 3 phenyl 1,2,4 oxadiazoles have been synthesised directly from benzamidoxime and perfluoromonoacyl chlorides. However, a more complex pattern of products was observed in the reaction between arylamidoximes and perfluorodiacyl chlorides. Depending on the conditions, the products were *O,O'*-perfluorodiacyl di (arylamidoximes), α,ω bis(3 aryl 1,2,4 oxadiazol 5 yl)perfluoroalkanes, and arylamidoxime (3 aryl 1,2,4 oxadiazol 5 yl)perfluorocarboxylates. The conversion of these novel salts, *via* their corresponding acids, into 1,2,4 oxadiazolyl perfluoro olefins, and attempts to polymerise these olefins are described. Author

N69-14826# Royal Aircraft Establishment, Farnborough (England).
OPTICAL AND ELECTRICAL PROPERTIES OF $ZnSiAs_2$
G. J. Burrell, J. C. Mabberley, T. S. Moss, and J. E. Snell May 1968 22 p refs
(RAE-TR-68115) Avail: CFSTI

A detailed study of the intrinsic absorption edge in single crystal $ZnSiAs_2$ has been made in order to derive a reliable value for the energy gap. Calculations of E–k curves and absolute absorption spectra have been carried out using k·p theory assuming various energy gaps and spin-orbit splitting energies for the valence band. A value of 2.16 ± 0.03 eV was derived for the energy gap at k=0 and a spin-orbit splitting of 0.25 eV, corresponding to a best fit between theory and experiment. A general study of the electrical properties of $ZnSiAs_2$ as a function of temperature is included. Hall effect and resistivity data have been obtained over the temperature range 108°K to 380°K and yield acceptor ionization energies of 0.24 and 0.58 eV. Spectral sensitivity curves for photoconductivity are compared with the absorption data. Photo-Hall experiments indicate that photoconductivity results solely from the production of free holes, which suggests that a high degree of electron trapping is operative. An appendix gives a detailed account of the derivation of intrinsic absorption spectra from Kane's k·p band theory. Author (ESRO)

N69-14843# National Bureau of Standards, Washington, D. C. Inst. for Materials Research.
INFRARED SPECTROSCOPY OF CARBOHYDRATES. A REVIEW OF THE LITERATURE
R. Stuart Tipson Jun 1968 25 p refs
(NBS-MONOGRAPH-110) Avail: Issuing Activity

A survey has been made of the literature on the infrared spectroscopy of carbohydrates, in order to assemble and systematize information in this field. The Monograph discusses principles and instrumentation, sampling techniques, comparison of samples, and the interpretation of the spectra, particularly as regards functional groups of carbohydrates and their derivatives, correlations for the fingerprint region and beyond, and conformational studies. In addition, examples are discussed of the use of infrared spectra for qualitative and quantitative purposes and in the determination of structure. Special techniques are briefly described, including use of plane-polarized radiation, the technique of attenuated total reflection, and Raman spectra. Author

N69-14856# Royal Aircraft Establishment, Farnborough (England).
THERMAL DEGRADATION OF AROMATIC IMIDES
J. L. Cotter and R. A. Dine-Hart Jun 1968 p 15 refs
(RAE-TR-68147) Avail: CFSTI

The principal gaseous products of the pyrolysis of poly-[N,N'-(p,p'-oxydiphenylene) pyromellitimide] at 540-680° are carbon dioxide and carbone monoxide; formation of carbon monoxide is favored at the higher temperatures. The pyrolysis results are consistent with the occurrence of two simultaneous decomposition processes; degradation of the imide ring yielding carbon monoxide, and an imide-isoimide isomerization leading to the formation of carbon dioxide. The behavior of the model compound phthalanil has also been examined; substitution of certain groups in the ortho position modifies the electron-impact behavior of the imide ring but has no apparent effect on the course of thermal breakdown. Author(ESRO)

N69-14863# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SATURATED LIQUID DENSITIES OF OXYGEN, NITROGEN, ARGON, AND PARAHYDROGEN
H. M. Roder, R. D. McCarthy, and V. J. Johnson 31 Jan. 1968 80 p refs
(NBS-TN-361) Avail: SOD $0.50

Integrated tables of pressure, volume, and temperature for the saturated liquid, from the triple point to the critical point, of oxygen, nitrogen, argon, and parahydrogen are presented. The tables include entries of integral values of temperature in both Kelvin and Rankine, and integral values of pressure in both atmospheres and psia. Volumes and densities in three different units and a density ratio are tabulated for each entry. Estimates of the uncertainty of the tabulated data are given. Author

N69-14924*# Brigham Young Univ., Provo, Utah.
STUDIES OF REACTION GEOMETRY IN OXIDATION AND REDUCTION OF THE ALKALINE SILVER ELECTRODE
Quarterly Report

Eliot A. Butler and Angus U. Blackham 15 Nov. 1968 47 p Prepared for JPL
(Contracts NAS7-100; JPL-952268)
(NASA-CR-98714; QR-2) Avail: CFSTI CSCL 07D

Determination of the kinetic parameters, i_0 and α, from additional galvanostatic polarization data on the $Ag/Ag(NH_3)_2^+$ system with a newly designed cell are reported and compared with values obtained previously from the cyclic current-step (c.c.s.) method. Extension of the c.c.s. method to the initial stage of oxidation of Ag in KOH was attempted. Maximum values of charge acceptance are observed at 0.30 volt and 0.52 volt (Hg/HgO reference). Surface area estimations were made at 0.32 volt where the charge acceptance vs. potential curve shows a plateau. Roughness factors determined by this potentiostatic method for electropolished silver foil, foil etched with nitric acid, and sintered silver were 1.1 to 1.3, 3 to 4, and 130 respectively. These values are larger than those obtained by the constant current method. The heights of the initial current peaks on these charge acceptance curves did not correlate reasonably with roughness factors. The influence of ultrasonic vibrations on silver electrodes is shown as an increase in charge acceptance of 5 to 25% during the Ag/Ag_2O oxidation plateau as a function of current density. Author

N69-15012# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.
MASS SPECTROMETRIC STUDY OF THE EVAPORATION OF BARIUM MOLYBDATE AND BARIUM TUNGSTATE Final Report, 1 Feb. 1966-31 May 1968
C. Pupp, R. Yamdagni, and Richard F. Porter 23 Oct. 1968 26 p refs
(Contract AF 19(628)-5831)
(AD-677008; AFCRL-68-0376) Avail: CFSTI CSCL 7/4

Mass spectrometric studies indicate that barium molybdate and barium tungstate salts evaporate mainly molecular BaMoO4(g) and BaWO4(g), respectively. The importance of ion fragmentation processes occurring in the mass spectrometer were established from appearance potential measurements and the variations in relative ion intensities with condensed phase composition. Third-law calculations give for the dissociation reactions: BaMoO4(g) = BaO(g) + MoO3(g), Delta-H = 129.7 plus or minus 4.0; BaMoO3(g) = BaO(g) + MoO2(g), Delta-H = 132.2 plus or minus 6.0; BaWO4(g) = BaO(g) + WO3(g), Delta-H = 148.3 plus or minus 4kcal. The heats of vaporization of BaMoO4(l) at 2000K are 83.5 and 93.7 plus or minus 4 kcal/mole, respectively. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N69-13910 Texas Univ., Austin.
MILLIMETER RADOME ELECTRICAL DESIGN TECHNIQUES
Donald Leroy Purinton (Ph.D. Thesis) 1967 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-4332

The traditional electrical radome wall designs, when extended from microwaves into the millimeter wavelength region, are limited in use due to lack of strength of the thin wall designs and poorness of electrical properties of the stronger thick wall designs. The integrated antenna-radome design, where energy is radiated or received through the use of a protective dielectric aperture, is proposed as an alternate to the conventional separated antenna-radome configuration. The most promising integrated designs for millimeter wavelengths are of the non-resonant or tapered types that do not require accurate dimensions. The recommended designs are: the lens-horn antennae, the dielectric rod antennae, the tapered depth slot antenna, the longitudinally-slotted dielectric loaded leaky wave slot antenna. The small physical size of these antennae at millimeter wavelengths makes them attractive for array mounting for high rate electrical scanning. Dissert. Abstr.

N69-13912*# Alabama Univ., University. Bureau of Engineering Research.
STUDY AND ANALYSIS OF TELEMETRY SYSTEMS FOR THE SATURN VEHICLE Final Report
Marvin A. Griffin Aug. 1968 16 p
(Contract NAS8-20172)
(NASA-CR-98187) Avail: CFSTI CSCL 09F

The work accomplished under this contract and extensions has consisted of a series of investigations and analyses of telemetry systems used on the Saturn vehicle. During the performance of this contract eleven interim technical reports consisting of about 1,400 pages have been published. These reports fully document the work which has been accomplished. This report consists of a brief summary of each of the eleven interim technical reports. Author

N69-13928*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MULTIPATH, POLARIZATION AND POINTING LOSSES FROM A MARS LANDER
H. K. Frewing 15 Dec. 1968 29 p ref
(Contract NAS7-100)
(NASA-CR-98570; JPL-TR-32-1333) Avail: CFSTI CSCL 17B

A model and a computer simulation program have been developed for statistically estimating the multipath, polarization, and pointing losses associated with the communication link from a planetary lander. The model allows these losses to be estimated for a lander of any configuration, with any antenna array, with any antenna characteristics and impacting at any position of any planet. It accounts for the random distribution of surface slopes likely to be encountered by a planetary lander. It assumes specular reflection of circular polarized waves as the multipath interference mechanism. Equations for computing multipath, polarization, and pointing losses are derived, as are the coordinate transformations required for converting the random impact conditions of a planetary lander into quantities required for the electromagnetic equations. One hundred computer simulated landings of a Mars rough lander are carried out for one landing in which the earth is 45 deg above the western horizon and for another landing in which the earth is overhead. Statistical distributions of combined multipath, polarization, and pointing losses are computed for each of these landing conditions. Author

N69-13965 Colorado Univ., Boulder.
DISTRIBUTIONS OF SUMS OF INDEPENDENT NAKAGAMI-RICE VECTORS WITH APPLICATIONS TO RADIO MULTIPATH
Martin Nesenbergs (Ph.D. Thesis) 1967 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-2651

Sums of two-dimensional, statistically mutually independent vectors are studied. The amplitudes were assumed to obey the Nakagami-Rice distribution, and all the phases were required to be uniform. To treat the distributions of this vector class, the bivariate characteristic functions were found to be expedient. For certain sums the amplitude probability density functions are unbounded; necessary and sufficient conditions for this phenomenon are specified, and singular cases are discussed in detail. A simple and directly

applicable Central Limit Theorem is presented that evokes a single condition shown to be both necessary and sufficient. The speed of convergence to the central limit is described in a natural, spherically symmetric way. To characterize this convergence, an arbitrary radial density function is represented as a weighted series of the derivatives of the Rayleigh density function. In applications to random fading processes, a related entity is of importance which is the slope of the amplitude probability density function at the origin. A number of properties and bounds are derived for this slope, but knowledge about its least upper bound is still inadequate. Dissert. Abstr.

N69-14007 California Univ., Berkeley.
OPTIMIZATION TECHNIQUES APPLIED TO PPM SIGNAL DESIGN
Robert John Mc Aulay (Ph.D Thesis) 1967 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-5778

A computer-oriented algorithm is developed for designing optimum waveforms for a pulse-position modulation communication system. Nonlinear modulation threshold effects are incorporated directly into the design by introducing constraints on the side-lobe peaks of the matched filter output. Numerical results obtained for a practical PPM design problem indicate that the threshold operating point can be reduced with little loss in optimality. A generalized Maximum Principle is derived and applied to the design problem to obtain necessary conditions for the optimum waveform. The resulting conditions were in the form of differential-difference equations of the advanced and retarded type which appeared to be impossible to solve. Steepest descent methods were investigated and a well-known gradient method was generalized to control systems having finitely many delay elements. A new modulation system, which uses phase modulation to improve the signal optimality criterion and pulse position modulation to control the threshold effect, is proposed and studied in detail. Dissert. Abstr.

N69-14109# Navy Underwater Sound Lab., New London, Conn.
QUASI-STATIC FIELDS WITHIN A TWO LAYER STRATIFIED EARTH PRODUCED BY A HORIZONTAL ELECTRIC DIPOLE ANTENNA
Peter R. Bannister 23 Sep. 1968 22 p refs
(AD-677280; USL-956) Avail: CFSTI CSCL 20/14

Expressions for the electromagnetic field components at the interface between the first and second layers of a two-layer conducting earth produced by a horizontal electric dipole antenna have been derived for the quasi-static range. Special attention has been given to the case where (1) the measurement distance is much greater than a skin depth in the upper layer but comparable to a skin depth in the lower layer and (2) the conductivity of the upper layer (sigma sub 1) is much greater than the conductivity of the lower layer (sigma sub 2). The special cases of (1) a thin layer, (2) a thick layer, and (3) sigma sub 2 >> sigma sub 1 are also considered. Author (TAB)

N69-14150*# Electronic Communications, Inc., St. Petersburg, Fla.
NASA MICROMIN COMPUTER Monthly Progress Letter, Jan. 1967
Harry C. Rudd, Jr., Donald C. Colbert, and Sterling Fisher 20 Feb. 1967 83 p
(Contract NAS8-20643)
(NASA-CR-98222; MPL-8) Avail: CFSTI CSCL 17B

Approximately half of the p.c. assemblies for the system breadboard have been completed. A phasing problem has been discovered with the Scott magnetic amplifiers and is being followed up by Scott. The system breadboard chassis assembly has been initiated and wiring interconnections will begin with the completion of the run wire list. Documentation is proceeding on the individual circuit schematics and the system block diagram. The reliability estimate will be completed when the circuit failure mode analysis is available. The report contains detailed descriptions of all micromin circuit designs. Author

N69-14224*# Avco Corp., Cincinnati, Ohio. Electronics Div.
SS/FM TELEMETRY SYSTEM STUDY Final Report, Jul. 1966–Feb. 1968
J. W. Mullaney 29 Feb. 1968 204 p
(Contract NAS8-11988)
(NASA-CR-98223; AVCO-80045-AKD-19/36B) Avail: CFSTI CSCL 09F

The SS/DSB Multiplexer frequency multiplexes 19 data channels with information up to 3.0 kHz into a base band of approximately 100 kHz. Each channel is multiplexed into SSB or DSB with suppressed carrier. The output data plus two pilot tones for phase coherent regeneration are followed by an AGC amplifier for constant energy in the base-band. A 1 kHz auxiliary channel (amplitude preserved) is also available for time sync information so that each channel may be time multiplexed for channel multiplication. Internal calibration of all channels is provided. No conclusions were drawn concerning the system's correspondence to anticipated results since fabrication was not completed. Individual modules were built and tested, however, and the results are presented. The appendices include: the filter tuning procedure, the prototype test procedure and data record sheet, and the preliminary breadboard report. The variations from breadboard to prototype design are noted in the appendix. Author

N69-14275*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
OPTICAL SYNTHETIC SIMULTANEOUS OBSERVATIONS BETWEEN BAKER-NUNN CAMERA STATIONS
Antanas Girnius and William L. Joughin 26 Jan. 1968 70 p refs
(Grant NaG-87-60)
(NASA-CR-98855; SAO Special Rept.-286) Avail: CFSTI CSCL 17H

From the time-overlapping sequences of precisely reduced simultaneous satellite observations made by the Baker-Nunn camera, directions were derived from the participating stations to single synthesized satellite positions. To determine these synthetic observations, we used an auxiliary coordinate system to avoid computational difficulties for observations of satellites close to the celestial pole. A least-squares fitting of the specified degree polynomial and an interpolation for the median overlapping time were made. Synthetic observations, reduced and corrected for the effects of planetary and diurnal aberrations, polar motion, and parallactic refraction, were converted to the terrestrial coordinate system and are expressed in the form of direction cosines. The angular satellite velocity, track angle, and the standard deviations along and across track were derived; the latest ones, combined with time uncertainties, were used as one low-quality observation rejection criterion. Author

N69-14277# Yale Univ., New Haven, Conn. Dept. of Astronomy.
STATISTICAL COMMUNICATION THEORY Final Scientific Report, 1 Apr.–31 May 1968
Jun. 1968 237 p refs
(Contract F19628-67-C-0112)
(AD-677340; AFCRL-68-0612; REPT-10) Avail: CFSTI CSCL 9/4

The report contains three current research efforts: arithmetic cyclic codes, the expanded codes as a special class of iterated codes and bounds on the signal bandwidth based on time samples. Author (TAB)

N69-14435# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
A NEW MONOPULSE-ANTENNA-EQUIPMENT FOR RECEIVING SATELLITE SIGNALS AT 136 MHz (MONOPULSE-ANTENNA, RECEIVER AND PEDESTAL) [EINE NEUE ANTENNEN-NACHFUHRANLAGE FUR DEN EMPFANG VON SATELLITENSIGNALEN BEI 136 MHZ (MONOPULS-ANTENNE, EMPFANGER UND DREHSTAND]
H. Ottl, F. Neugebauer, H. Haerter, and M. G. Fey Sep. 1968 100 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-62) Avail: CFSTI

The DVL build up a newly developed tracking station. The gained results are given. The antenna was designed by DVL and produced by Rohde & Schwarz. It has a good side lobe suppression and a high aperture efficiency. A description of the receiving system and the pedestal is given. On both some modifications and improvements have been made. The tracking accuracy is estimated partly by measurement and computation, partly by simulation on an analog computer. The results are confirmed by practical experiments with movable signal sources (aircraft, satellite). Author

N69-14461#
CHAPTER 1: PECULIARITIES OF PHASE SYSTEMS
V. B. Pestriakov [1968] 13 p Transl. into ENGLISH from the book "Fazovye Radiotekhnicheskie Sistemy" Moscow, Sovetskoe Radio Press, 1967 p 7–20
Avail: CFSTI

Phase systems, considered to be those in which the useful information is embedded in the phase of the signal, are mathematically defined as the argument of the harmonic function. Equations are also derived to show that the phase shift for oscillations with different frequencies is a function of time. Various types of phase systems are assessed, and several examples of modulation methods are discussed. Phase utilization in radio communication systems is examined, with consideration given to the problems involved in phase lag, phase manipulation, synchronization, frequency manipulation, signal noise, and delay synchronization systems. M.G.J.

N69-14465# General Electric Co., Syracuse, N. Y. Electronics Lab.
INTERFERENCE REDUCTION TECHNIQUES FOR FREQUENCY CONVERTERS Final Report, 1 Apr. 1967–15 Aug. 1968
G. Burton Harrold and Glen B. Gawler Ft. Monmouth, N. J. Army Electron. Command Oct. 1968 186 p refs
(Contract DAAB07-67-C-0327)
(AD-677407; ECOM-0327-F) Avail: CFSTI CSCL 9/5

The theory and basic design of typical radio frequency converter sections were investigated to determine their interference-producing and interference-susceptibility characteristics. A major part of the study consisted of the investigation of analytical techniques to be applied to frequency converters to arrive at recommendations for the reduction of such outputs. During the program, newer analytical approaches were applied to represent the frequency convertar function, which, in turn, led to a better understanding of the frequency converters characteristics, so improvements in performance could be made. A two-fold analytical approach was used: (1) representation of frequency converter functions by means of Fourier series and Chebyshev polynomials or by least-mean-square error polynomials, and (2) viewing the frequency converter as a time-varying network and applying a state variable representation and vector differential equation techniques to obtain a solution. In the first area of endeavor, use was made of Fourier series and Chebyshev polynomials as analytical tools. Further investigation took place to evaluate the application of polynomials having the least-mean-square error between the converters transfer function and the representing polynomial. Author (TAB)

N69-14473# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COLOR TV BRIDGE: PARIS TO MOLNIYA-1 TO MOSCOW
A. Fortushenko Dec. 1967 5 p Transl. into ENGLISH of Pravda (Moscow), no. 150, 30 May 1966 4 p
(AD-677233; FTD-HT-23-1137-67) Avail: CFSTI CSCL 17/2

On 28 May at the Moscow Television Center there was a demonstration of reception of color TV. It was transmitted from Paris via the Soviet satellite Molniya-1. This was the result of an agreement concluded between France and the USSR in March 1965 for cooperation in the joint development of a system for transmission of color television. A test run of the satellite system was made in November 1965 with transmission of a program from Moscow to Paris. On 28 May the TV images were transmitted along a cable to a large antenna situated outside Paris and then to the Soviet satellite, which carries a powerful 40-W transmitter. The transmission was received over a wide area. It was received near Moscow and transmitted by land line to the Moscow Television Center. The color image was shown in an auditorium, automatically magnetically recorded and fed to a television transmitter. Soon it will be feasible to have regular black-and-white and color TV transmission between the USSR and France via the Molniya satellite. The sound accompaniment for the program was fed along a land cable. For regular transmissions it will be necessary to arrange simultaneous transmission of sound and picture via the satellite as is now done for black and white transmission. Author (TAB)

N69-14520# Syracuse Univ. Research Corp., N. Y. Systems Synthesis Lab.
A METHOD TO DETERMINE AN EFFECTIVE RADIO REFRACTIVITY PROFILE BY DIRECT RADIOMETRIC MEASUREMENTS, FEBRUARY 1–SEPTEMBER 1, 1968
Lyall G. Rowlandson Bedford, Mass. Electron. Systems Div. 30 Jan. 1968 44 p
(Contract F19628-68-C-0209)
(AD-677027; ESD-TR-68-307) Avail: CFSTI CSCL 20/14

A vertical reflection interferometer may be used to record the signal received from an airborne source. As the source rises in height a multipath fading pattern is produced. At each ordered fade the experimental geometry can be used to determine a value for an effective earth radius. It is shown that each value of earth radius can be related to an effective refractivity gradient with height from which the refractivity profile can be constructed. The experimental procedure is based on the results of a comprehensive radio propagation experiment performed at Cold Lake, Alberta, from which it was determined that the effective earth radii could be measured to plus or minus 200 nm average using radiometric methods only. Author (TAB)

N69-14539# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PULSE-CODE INFORMATION RECEIVER
V. F. Dmitriyev 15 Dec. 1967 5 p Transl. into ENGLISH from Russian Patent no. 176623 (Appl. no. 880900/28-24, 10 Feb. 1960) 2 p
(AD-677230; FTD-HT-23-1124-67) Avail: CFSTI CSCL 17/2

A pulse-code information receiver is introduced. To simplify the entire system, an AND element is provided, its output is coupled to the register input, and its input is connected to the register output through the channel divider. The pulse-code information receiver includes: (1) - threshold unit, (2) - coincidence circuits, (3) - clock-pulse generator, (4) - register, (5) - channel divider, (6) - resolution unit, (7) - code control unit, (8) - AND element. TAB

N69-14584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ORBITA—COMMUNICATIONS VIA SPACE: SUPER LONG RANGE TELEVISION TRANSMISSION SYSTEM BEGINS OPERATION
8 Dec. 1967 9 p refs Transl. into ENGLISH from Pravda (Moscow), 29 Oct. 1967 p 3
(AD-677243; FTD-HT-23-1594-67) Avail: CFSTI CSCL 17/2

The network of Orbita stations - receiving points for television programs transmitted via molniya-1 communication satellites - is going into operation. More than twenty receiving stations were built in remote areas of Siberia, the Extreme North, the Far East, and in Central Asia. As a result of this accomplishment, Central Television programming is now being enjoyed by more than twenty million additional viewers. TAB

N69-14602# National Severe Storms Lab., Norman, Okla.
PROBABILISTIC MODELS FOR RADAR ECHO DISTRIBUTIONS AND THEIR RELATIONS TO TURBULENCE ENCOUNTERS BY AIRCRAFT
Edward A. Newburg Oct. 1968 12 p refs *Its* Tech. Circular No. 6
Avail: Issuing Activity

Three methods are presented for rating the probability of an aircraft encounter with a radar echo area, to statistical properties of echoes and to the flight path. Means for improving the statistical description of radar echo areas are also discussed. Author

N69-14722# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TELEVISION TRANSMISSIONS FROM OUTER SPACE
G. B. Bogatov 14 Dec. 1967 242 p Transl. into ENGLISH of the book "Televizionnye Peredachi Iz Kosmosa" Moscow, Izd. Nauka, 1966 p 1-304
(AD-677518; FTD-MT-24-229-67) Avail: CFSTI CSCL 17/2

The book tells about use of television equipment during manned space flights and about what role television will play in the organization of extraterrestrial observatories on artificial and natural celestial bodies. There are discussed problems of transmission of radiotelevision signals over cosmic distances and prospects of using for targets of space television communication of electromagnetic oscillations of the optical range of waves, and corresponding equipment is described. The book goes into detail about existing and planned use of spacecraft for relaying television programs over intercontinental distances. Principles of organization of systems of ground radio reception and radio command network, methods of registering television signals and special methods of treating received signals are described. Author (TAB)

N69-14739 Syracuse Univ., N. Y.
A STATISTICAL ANALYSIS OF SITING ERROR IN RADIO DETECTION-FINDING
Laurence Anthony Lyons (Ph.D. Thesis) 1967 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-5474

A statistical model of a site is devised to analyze the effect of extended reradiators (e.g., hills, buildings) on D/F accuracy. Such a model applies to the majority of D/F sites encountered in practice. A series of assumptions leads to an explicit expression for the probability density distribution of the electric field amplitude at the direction-finder as each of two quantities is varied: A) the azimuthal position of a target transmitter; B) the frequency of a target transmitter. The new results contained in this work are as follows: 1) The application of statistical methods to D/F site selection. 2) The introduction of a single-parameter evaluation of a site. The single parameter proposed is a physically acceptable measure of site quality and can be directly related to the accuracy of a specific direction-finder on a given site. 3) The equivalence of measurements at various angles of arrival (A, above) to measurements at various frequencies (B, above). This is probably the most useful single result of the investigation. 4) A means of correcting for the presence of a few obstacles in the vicinity of the direction-finder. Dissert. Abstr.

N69-14780# Signals Research and Development Establishment, Christchurch (England).
A MOBILE UHF PASS LOSS MEASURING EQUIPMENT
A. H. Johnson, R. S. Keeble, and A. M. J. Mitchell May 1968 42 p refs
(SRDE-68010)

The design, construction and performance of a radio path loss measuring equipment, for use at 806 MHz, is described. Path losses (up to 171 dB (referred to isotropic radiators) may be measured to an estimated accuracy of ±2 dB. Pneumatically operated telescopic masts readily permit measurements at antenna heights up to 70 ft. Author (ESRO)

N69-14797*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
COMMUNICATIONS AND TRACKING RELAY EXPERIMENT STUDY PROGRAM Final Report
Bruce Mosher 28 Dec. 1968 163 p refs
(Contract NAS9-8199)
(NASA-CR-92445; Rept-3503-T1) Avail: CFSTI CSCL 17B

A detailed summary is presented on the system design and analysis, laboratory testing, and the recommended basic communications and tracking (CAT) relay system design which was performed by Motorola during the CAT relay experiment study program. The experiment fundamentals which were assumed, calculated and NASA defined are reviewed. Based upon these fundamentals, the system design analysis and laboratory simulation test results are presented. The basic CAT Relay System recommendations are then determined and detailed from the analysis, test results, and equipment tradeoff studies. The available alternatives to the basic system design are defined, the metric tracking accuracy analysis presented, and the laboratory demonstrations summarized. Author

N69-14832# Royal Aircraft Establishment, Farnborough (England).
A TONE DIGITAL COMMAND ENCODER FOR LABORATORY USE
D. E. Verrian May 1968 p 22 ref
(RAE-TR-68129) Avail: CFSTI

The equipment described produces satellite command signals encoded in accordance with the NASA Tone Digital Command Standard. It operates by pulse duration modulation of a subcarrier on which time redundant coding is impressed to provide for error detection. The output is compatible with the input requirements of the Black Arrow satellite command decoder, and also suitable for input to a command transmitter. ESRO

N69-14837# Selenia S. P. A., Rome (Italy).
ELDO VEHICLE ANTENNA PATTERNS. VOLUME 1: INTRODUCTION AND STV-4000 MHz ANTENNA
Paris ELDO 18 Mar. 1968 20 p
(ELDO-RFI-9B, App. 1, v. 1) Avail: CFSTI

STV beacon antenna radiation patterns are presented for the ELDO launch vehicle in the F6-1 and F6-2 configurations. Author (ESRO)

N69-14838# Selenia S. P. A., Rome (Italy).
ELDO VEHICLE ANTENNA PATTERNS. VOLUME 2: TRANSPONDER A AND B ANTENNAS
Paris ELDO 18 Mar. 1968 p 39
(ELDO-RFI-9B, App. I, v. 2) Avail: CFSTI

Transponder antenna radiation pattern diagrams are presented for the ELDO launch vehicle in the configurations F6-1 and F6-2.
ESRO

N69-14839# Selenia S. P. A., Rome (Italy).
ELDO VEHICLE ANTENNA PATTERNS. VOLUME 3: GUIDANCE TRANSPONDER (STAGE 3) ANTENNA
Paris ELDO 18 Mar. 1968 63 p
(ELDO-RFI-9B, App. 1, v. 3) Avail: CFSTI

The guidance transponder antenna (3rd stage) radiation pattern diagrams are given for the ELDO launch vehicle in the F6-1 and F6-2 configurations.
ESRO

N69-14840# Selenia S. P. A., Rome (Italy).
ELDO VEHICLE ANTENNA PATTERNS. VOLUME 4: GUIDANCE TRANSPONDER (STV) ANTENNA
Paris ELDO 18 Mar. 1968 95 p
(ELDO-RFI-9B, App. 1, v. 4) Avail: CFSTI

Satellite guidance transponder antenna radiation pattern diagrams are given for the ELDO launch vehicle in the F6-1 and F6-2 configurations.
ESRO

N69-14841# Michigan Univ., Ann Arbor. Radiation Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF PARASITIC LOOP COUNTERPOISE ANTENNAS Final Report, 16 Jun. 1967–16 Jun. 1968
D. L. Sengupta, J. E. Ferris, and V. H. Weston Sep. 1968 120 p refs
(Contract FA-65-WA-1299)
(SRDS-RD-68-50; REPT-8905-1-F; SR-3) Avail: Issuing Activity

Theoretical and experimetal investigations of the radiation field produced by a single parasitic loop counterpoise antenna are presented. Geometrical theory of diffraction is applied to obtain theoretical expressions for the far field produced by such an antenna. Within the range of approximation the agreement between theory and experiment has been found to be very good. In the absence of mutual coupling between the parasitic elements, the present theory can be applied to double and multiple-parasitic loop counterpoise antennas. The parasitic loops in general reduce the counterpoise edge diffraction effects on the far field patterns. The behavior of the parasitic loop counterpoise antenna pattern near the principal maximum is not appreciably different than the Alford loop counterpoise pattern near its maximum. Parasitic loops increase the response of the antenna in regions of space near the zenith ($\theta = 0°$. On the basis of the investigation it is concluded that when suitably designed, the parasitic loop counterpoise antenna is potentially capable of minimizing the siting errors associated with existing VOR systems. Three new antenna systems which may find possible application in a VOR system have been proposed.
Author

N69-14844*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOICE BROADCAST MISSION STUDY (VBMS). VOLUME 1: SUMMARY Final Report
22 Sep. 1967 43 p
(Contract NASw-1475)
(NASA-CR-98710; GE-67SD4330-Vol-1) Avail: CFSTI CSCL 17B

A brief summary is presented of the voice broadcast mission study results to investigate the technological and cost factors associated with unmanned satellites for the direct broadcast of aural material to unmodified home receivers. The variables for system selection involved people, environment, equipment, and time. Systems were evaluated and conceptually designed to be available in the early 1970's. Three frequency bands were considered: HF/AM, VHF/FM, and UHF/FM; their characteristics summarized; and configurations postulated.
B.P.

N69-14845*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOICE BROADCAST MISSION STUDY. VOLUME 2: STUDY REPORT Final Report
14 Jul. 1967 399 p
(Contract NASw-1475)
(NASA-CR-98711; GE-67SD4330-Vol-2) Avail: CFSTI CSCL 17B

An in-depth study is presented of satellite designs for direct broadcast of voice programs to home receivers. A mission analysis was performed to generate data needed to specify the systems requirements. Systems analysis specified the subsystem requirements for satellites to broadcast in the HF, VHF, and UHF frequency bands. Technology evaluations were performed to select and define the necessary subsystems for the four configurations conceived for the three frequency bands and conceptual drawings are depicted. The four satellite systems were evaluated in terms of performance, program plans, system costs and cost effectiveness, and recommendations are made for the technology developments necessary to reduce these concepts to hardware. Among the significant technical results derived were: (1) Only circular, equatorial orbits are practical for broadcasting at the same time on a daily repeat basis throughout the year. (2) Propagation effects are essentially limited to a factor of two except at extreme latitudes. And (3) Man-made noise is a predominant satellite sizing factor to reach urban audiences in the HF and VHF bands, while building attenuation is an important factor at UHF.
B.P.

N69-14846# Selenia S. P. A., Rome (Italy).
ELDO INITIAL PROGRAMME: RADIOFREQUENCY INTERFERENCE: F6/1 AND F6/2 MULTISTAGE VEHICLE: AERIAL PATTERNS AND DECOUPLING MEASUREMENTS CARRIED OUT ON A SCALED MODEL 1/6.5 OF THE VEHICLE ANTENNA SYSTEMS ABOVE 500 MHz
Paris ELDO 18 Mar. 1968 34 p refs
(ELDO-RFI-9B) Avail: CFSTI

The report describes the mutual coupling measurements made on the antennas mounted on the ELDO launch vehicle in the configurations F6-1 and F6-2 (scale model 1/6.5) at frequencies of 500 MHz and above. The purpose was to establish the electromagnetic compatibility among the radiofrequency equipment.
ESRO

N69-14864# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. for Flugfunk und Mikrowellen.
DESCRIPTION OF A DIGITAL COMPUTING PROGRAM EVALUATING THE TROPOSPHERIC AND IONOSPHERIC ANGLE AND RANGE ERRORS [BESCHREIBUNG EINES DIGITALEN RECHENPROGRAMMS ZUR ERMITTLUNG DES TROPOSPHARISCHEN UND IONOSPHARISCHEN WINKEL- UND ENTFERNUNGSFEHLERS]
P. Edenhofer and D. Giesner Aug. 1968 50 p refs In GERMAN; ENGLISH summary
(DLR-MITT.-68-17; DVL-738) Avail: CFSTI

A digital computer program (ALGOL) to evaluate the angle and range error caused by the troposphere and ionosphere when

earth satellites are observed by means of electromagnetic waves is described. An explanation is given of the necessary input data and the output data supplied by the program. Finally, some characteristic examples are computed indicating the general use of the program. Author

N69-14934# Oulu Univ. (Finland). Dept. of Electrical Engineering.
CURVES FOR THE REFLECTION OF RADIO WAVES FROM AURORAL IONIZATION
J. Oksman 1968 14 p refs
(S-1) Avail: CFSTI

Curves of constant values of the propagation angle in geographic coordinates are given for some representative places in Finland. Using these curves, the optimum location of auroral ionization for reflections in the radar and in the bistatic case can be determined. Some examples of the latter are given, leading to a proposed measurement program. Author

N69-14970#
ONE.SIX. PULSE-PHASE SYSTEMS; 1.7. FUNDAMENTAL PROBLEMS
V. B. Pestriakov [1968] 10 p refs Transl. into ENGLISH from the book "Fazovye Radiotekhnicheskie Sistemy" Moscow, Sovetskoe Radio Press p 35–42
Avail: CFSTI

Fundamental problems of pulse-phase systems center on utilization of information contained in the signal phase to obtain the most confident information in the presence of interference. Accurate determination of coordinates and motion elements is needed for production of noise signals with high interference immunity. Insignificant distortions of phase propagation by 10^{-5} to 10^{-6} and by a phase front of 0.01° can result in main errors. Statistical radio engineering methods are needed to obtain theoretical solutions during synthesis and optimization analyses on phase systems. G.G.

N69-14973*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
RADIO BRIDGE: "EARTH-MOON-EARTH" [RADIOMOST: 'ZEMLYA-LUNA-ZEMLYA']
V. Ye. Demidov Washington NASA Jan. 1969 47 p refs Transl. into ENGLISH from Russian
(Contract NASw-1692)
(NASA-TT-F-527) Avail: CFSTI CSCL 17B

Problems in providing a reliable communications system for passage of signals from the earth to the moon and back are examined. Selection of the appropriate type of modulation, and the elimination of noise; the selection of optimal frequencies, and systems for coding transmission are considered. The use of the earth–moon–earth radio link, as a means of communications with space stations and isolated points on the earth, is investigated. F.O.S.

N69-15008# Interim Communications Satellite Committee.
REPORT OF THE INTERIM COMMUNICATIONS SATELLITE COMMITTEE ON DEFINITIVE ARRANGEMENTS FOR AN INTERNATIONAL GLOBAL COMMUNICATIONS SATELLITE SYSTEM
15 Dec. 1968 94 p
(ICSC-36-55E-W/12/68) Avail: Issuing Activity

An extensive report is presented by the Interim Communications Satellite Committee (INTELSAT) defining arrangements between governments which signed the agreement establishing the committee for a global commercial communications satellite system. Approximately 80 documents offering detailed proposals and statements of principle were submitted and considered by INTELSAT. A factual account of the origins and structure of INTELSAT and an outline of progress since August 1964 is summarized. The financial status of INTELSAT as of the end of 1968, including operating results and capital expenditure projections, is tabulated. B.P.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N69-13977# Brookhaven National Lab., Upton, N. Y.
A COMPILATION OF NEUTRON-INDUCED THRESHOLD REACTIONS
B. A. Magurno *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 97–111 refs Supported by AEC (See N69-13971 04-24)
Avail: CFSTI

The National Neutron Cross Section Center is composed of the compilation group, the evaluation group, and programming support necessary to meet the demands of the Center. The data have been published periodically as compilations; e.g., BNL 325, "Neutron Cross Sections," and BNL 400, "Angular Distributions." A joint effort by BNL and several other laboratories to evaluate the data is under way. The results of this effort are presented as the Evaluated Nuclear Data File (ENDF/B). Data are available by request on magnetic tape, punched cards, or printout listings. Not all potential users require the data in the above forms; a pictorial representation is one alternative. A study to provide such a representation is in progress. Data for a selected set of neutron-induced threshold reactions have been collected. The reactions have been plotted as functions of energy, and fits are being made. Examples are shown and discussed. Author

N69-14021 Texas Univ., Austin.
ON THE STRUCTURE OF SEQUENTIAL MACHINE REALIZATIONS
Charles Alton Harlow (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-4288

In most studies of the structure of sequential machines there has been a tacit assumption that the machine was to be realized with unit delay memory elements. Here sequential machines that are realized with either trigger or set-reset flip-flop memory elements are considered. It is shown that the relation called a partition pair which predicts the dependence of the input functions to unit delay memory elements does not predict the dependence of the input functions to trigger or set-reset flip-flop memory elements. Relations called t-pairs and r-pairs are defined which characterize the dependence of the input functions to trigger and set-reset flip-flop memory elements respectively. It is found that these relations do not have all the algebraic properties that partition pairs possess. Feedback in sequential machines that are realized with trigger or set-reset flip-flop memory elements was also studied. A method is given for determining when a machine can be realized with either trigger or set-reset flip-flop memory elements using function f for feedback. Dissert. Abstr.

N69-14038*# Radio Corp. of America, Princeton, N. J. RCA Labs.
RESEARCH TO DEVELOP MASS DATA STORAGE
A. D. Robbi, S. Katz, and C. Wentworth Aug. 1968 55 p refs
(Contract NAS12-674)
(NASA-CR-86115) Avail: CFSTI CSCL 9B

The laminated ferrite technology, combined with integrated MOS-bipolar circuitry, has the potential to realize a low-power, mass random-access memory operating at a 2.5-μsec cycle time. The fabrication of the ferrite planes by pressure-sintering yields storage planes with protruding conductors on regular center spacings. The pressure-sintering was developed sufficiently to produce planes with acceptable mechanical and magnetic properties if the conductors are platinum (maximum processing temperature of 1230°C). Further development is required to lower the processing temperature to accommodate gold conductors (melting temperatures of 1063°C). The combination of p-channel MOS devices and n-p-n bipolar transistors in the integrated address selection, current drive, and sense circuitry results in optimum performance consistent with low power drain. A 13-million-bit module, 65,536 words × 200 bits, consuming 20 to 25 watts is estimated to occupy 4 to 6 cubic feet. The electronics complement of the module includes 65,536 integrated bipolar drivers, a 1024-output binary-tree address decoder, 200 sense amplifiers, 200 dual unipolar digit drivers, and a 200 × 16 digit-sense multiplex circuit. These circuits were designed and evaluated in breadboard form. Author

N69-14051# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN ANALOG TO DIGITAL LOGARITHMIC CONVERTER BASED ON AN OSCILLATING CIRCUIT

Yu. V. Mineyev et al 9 Nov. 1967 7 p refs Transl. into ENGLISH from Vestn. Ser. III Fiz., Astron. Moscow Univ. (Moscow), no. 1, 1967 p 123–125

(AD-677224; FTD-HT-23-1099-67) Avail: CFSTI CSCL 9/5

A transistorized logarithmic analog-to-digital converter of d-c voltage into pulses is described. The input voltage (3 mv - 3 v) is first converted into voltage pulses by a sampling gate circuit. These voltage pulses excite an LC circuit whose oscillations are tuned to resonate with the gate control pulses. The output of the LC circuit is amplified, limited, and fed to an amplitude discriminator, whose output is a packet of pulses. The number of pulses in the packet is proportional to the logarithm of the input d-c voltage. TAB

N69-14058# Argonne National Lab., Ill.

COMPUTER ENVIRONMENT REPORT

M. K. Butler and A. L. Rago Feb. 1968 180 p refs

(Contract W-31-109-ENG-38)

(ANL-7408) Avail: CFSTI

The Argonne computer environment report includes a description of the software systems and hardware devices for the IBM 360 and CDC 3600 and the peripheral and special purpose equipment. Copies of internal publications describing ANL-produced utility routines currently used by many of the computer programs and program systems prepared or developed at Argonne are included as appendices. NSA

N69-14063# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A MACHINE FOR SOLVING LOGIC PROBLEMS OF THE RELAY-NETWORK SYNTHESIS TYPE

A. D. Zakrevskiy 27 Oct. 1967 14 p ref Transl. into ENGLISH from the book "Sintez Releynykh Struktur" Moscow, Nauka, 1965 p 346–356

(AD-677256; FTD-HT-23-1350-67) Avail: CFSTI CSCL 9/5

A machine concept for switching problems has been developed at the Tomsk University which consists of a general-purpose computer plus an L-machine, which allows the former to carry out additional operations important in Boolean minimization problems. Three types of L-machine operations are distinguished: (1) The mu-operation which is equivalent to a two-position operation on a 10-argument Boolean function; (2) The nu-operation which is an information exchange between the principal field A and the digital-computer storage; it also covers some more complex A-field operations; (3) The lambda-operation which is realized according to a subroutine taken from the computer storage and expressed in the language of U-, mu-, or nu-operation. Examples of the above operations are illustrated graphically. Simulation of the L-system on a general-purpose computer corroborated the L-system advantages which are claimed to be: simple programming and quicker solutions. TAB

N69-14078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME PROBLEMS REGARDING THE CONSTRUCTION OF ANALOG TO DIGITAL CONVERTERS APPLICABLE FOR LOW-LEVEL INPUT SIGNALS

P. N. Kopay-Gora et al 29 Nov. 1967 11 p Transl. into ENGLISH from the book "Analogovaya i Analogo-Tsifrovaya Vychislitel'naya Tekhnika" Izd. Mashinostr., Moscow, 1965 p 277–286

(AD-677693; FTD-HT-23-1413-67) Avail: CFSTI CSCL 9/5

Usually for conversion of low voltages, on the order to 10-100 mv, to digital code, these voltages are first amplified by a factor of about 1000. Another method is suggested for construction of a converter which does not require pre-amplification of the signal. In this method the converter uses a high sensitivity comparison circuit (sensitivity on the order of 5-10 microvolts), and a compensating voltage received from a code-to-voltage converter is fed to a divider and then to the comparison circuit. The divider achieves equality of the input and compensating voltages. A block diagram of the comparison circuit is presented and briefly described. It is a highly sensitive dc amplifier constructed on the modulation-demodulation scheme. Schematic diagrams of the transistorized keys used in the modulator and code-voltage converter are presented. It is noted that in order to provide the required accuracy of measurements, a portion of the converter must be kept under temperature control, and strobing must be used in the comparison circuit. TAB

N69-14080# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A MATRIX p-LANGUAGE FOR THE DESCRIPTION OF PARALLEL ALGORITHMS

E. V. Yevreinov et al 9 Nov. 1967 8 p ref Transl. into ENGLISH from Sibirsk. Otdel. Inst. Mat. Vychislitel'nyye Sistemy, Akad. Nauk SSR

(AD-677241; FTD-HT-23-1421-67) Avail: CFSTI CSCL 9/2

A matrix language is introduced for describing systems of parallel algorithms. Simple and generalized operators are used as elements of the language. The generalized operators are sequences of several simple operators if (1) one and only one of the simples in it has an outside input; (2) only one operator is executed at each moment of time, (3) all simple operators will be executed in a finite number of steps after the operators having an outside input are executed. Established designations are used for some of the more frequently encountered operators. Several standard p-operators are considered. TAB

N69-14097*# Sperry Rand Research Center, Sudbury, Mass.

INVESTIGATION OF NEW CONCEPTS OF ADAPTIVE DEVICES

H. A. R. Wegener Sep. 1968 122 p

(Contract NAS12-570)

(NASA-CR-86114; SRRC-CR-68-43) Avail: CFSTI CSCL 09B

This report describes the work done with a new memory device. This memory device is an IGFET whose threshold voltage can be increased or decreased reproducibly by applied voltage pulses. The amount of change depends on the amplitude and

duration of the pulse, and the direction of the change depends on the polarity of the pulse. This property makes this transistor the first semiconductor device that permits electrically alterable, nonvolatile storage of information. The investigation of this device has led to the establishment of typical operating parameters of the storage function: roughly a ± 5 V threshold change for writing voltage pulses of the order of ± 30 to ± 60 V, typical write-in times of the order of 10^{-2} to 10^{-4} seconds (with 10^{-6} seconds possible), and storage times of the order of several months observed (and many years storage expected from extrapolations of data). Author

N69-14110*# Bendix Corp., Baltimore, Md. Communications Div.
DIGITAL FILTERING AND PROCESSING BY TRANSFORM TECHNIQUES, VOLUME 1 Final Report
Edgar H. German, Jr. 30 Jun. 1968 553 p refs
(Contract NAS8-20308)
(NASA-CR-98190) Avail: CFSTI CSCL 09B

A complete programming and engineering level discussion of the various aspects of digital filtering is given. Relations between analog and digital signals and systems are discussed for the instance where data is derived from analog situations. Limitations on simulation of analog systems are presented. Various transform techniques are given and compared. Linear, time invariant digital filters are defined, conditions for realizability given, and forms of realization enumerated. A wide variety of synthesis methods for both recursive and non-recursive digital filters are given with advantages and limitations. Filtering with the two component complex modulation is defined and complex filter synthesis methods developed. Descriptions of basic statistical concepts are presented. Also discussed are methods of statistical spectrum analysis and linear statistical function estimation. Numerous applications to digital systems are described. The modern fast discrete Fourier transform is described in detail and integrated, where applicable. Author

N69-14122# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
DECUR 5: A PDP-8 PROGRAMME FOR PROCESSING DATA FROM SCALERS PUNCHED ON PAPER TAPE
J. G. Cuninghame Jun. 1968 52 p ref
(AERE-M-2077) Avail: CFSTI

A program for the 4K PDP-8 computer which accepts punched paper tape containing decay curve information from scalers is described. The program sorts the information out and reproduces it, either as tapes in a format suitable for further processing in a large computer, or as a printed record of calculated counts per minute corrected for counter background and paralysis, together with the calculated mid-point of the count. These data are therefore ready for plotting a decay curve directly. Author (NSA)

N69-14157*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE SCIENCE WRITING AT A DOWN TO EARTH LEVEL
Jan. 1968 134 p Seminar held 20 Jan. 1968
(NASA-TM-X-58024) Avail: CFSTI CSCL 05B

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1. SPACE COVERAGE—PERILS, PROBLEMS, AND THE PAYOFF J. Bergman (ABC) p 3–13 (See N69-14158 04-30)

2. NEWS COVERAGE OF MANNED SPACE MISSIONS P. Haney p 14–19 (See N69-14159 04-08)

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10. STYLE IN TECHNICAL WRITING L. Alexander (Houston Univ.) p 124–130 (See N69-14167 04-08)

N69-14159*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NEWS COVERAGE OF MANNED SPACE MISSIONS
Paul Haney *In its* Space Sci. Writing at a Down to Earth Level Jan. 1968 p 14–19 (See N69-14157 04-08)
Avail: CFSTI CSCL 05A

The problems encountered by the Government public affairs and press officers in reporting the early stages of the rocket and missile programs are reviewed, and the many inconsistencies in the official policy toward releasing information are recounted. The public excitement engendered by the Shepperd and Glenn flights is reviewed, along with the public ennui following the other successful manned space flights. The problems involved in keeping the public tuned into the space program are linked to the fact that no news media reports the millions of children who return safely from school. An assessment is made of the fundamental problems within NASA and industry itself: of the engineer who won't talk until the third time around, of the scientist who is waiting until his article is published, and of the workers who invoke national security when they really mean job security. The purpose of a NASA public relations officer is defined as close to a librarian who dispenses the information required. M.G.J.

N69-14160*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE ROLE OF THE TECHNICAL WRITER IN THE EARTH RESOURCES SURVEY PROGRAM
Charles M. Grant, Jr. *In its* Space Sci. Writing at a Down to Earth Level Jan. 1968 p 20–44 (See N69-14157 04-08)
Avail: CFSTI CSCL 05B

The Earth Resources Survey Program is discussed in terms of the objectives, the equipment and test sites, the users, and the way the technical writer will interface with the program. The objectives are defined as developing the best combination of instrumentation, procedures, and interpretational methods for gathering resource data and testing these in experimental spacecraft, and discovering and delineating those earth resources from space which will be of economic value to the nation and the world. The technical writer's role is seen as one which is needed from the planning phase through the final report preparation phase. A varied background of education and experience is cited as a basic background for these writers. More specific requisites for writers in this field are listed as a degree in earth science or engineering with courses in physics or chemistry. Particular stress is placed upon the responsibility of the technical writer to relieve the engineers and scientists of the burden of preparing the data and seeing that it is disseminated to the scientific community and to the ultimate users. M.G.J.

N69-14161# International Business Machines Corp., Houston, Tex. Federal Systems Div.

SPACE DOCUMENTATION—A BOON TO THE CONTRACTOR

Joseph Godfrey *In* NASA. Manned Spacecraft Center Space Sci. Writing at a Down to Earth Level Jan. 1968 p 45–50 (See N69-14157 04-08)

Avail: CFSTI

The importance of space research documentation is discussed in relation to getting the right data from the tremendous volume in the information bank to the right people. Consideration is given to the new technology clause in each NASA contract and the ways devised by contractors to have this clause implemented and enforced by contractor representatives working with the design engineer, mechanic, tool maker, and technician to make them alert to any uses of inventions, discoveries, improvements, and innovations made under NASA contracts. The point is made that most space technological breakthroughs are based on previous discoveries; therefore, the documentation of every phase of every program from each location, and its availability to everyone with a need at every location, is seen as the only possible way to bring together all of the required information for any company development. Emphasis is placed on the contribution made to the space program by the manuals, reports, articles, speeches, and films which have gone into the aerospace information bank. M.G.J.

N69-14162*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

TODAY AND TOMORROW

F. Curtis Michel *In its* Space Sci. Writing at a Down to Earth Level Jan. 1968 p 51–55 (See N69-14157 04-08)

Avail: CFSTI CSCL 05B

The budgetary cuts made in the space program are discussed in the context of what these cutbacks mean in breaking up highly trained scientific teams, and in the modification of the Apollo Applications Program. The view is offered that after a lunar landing a certain gap in the space program will occur, with manned space exploration eliminated for a few years. Stress is placed on the urgent need for planning. From the technical writing viewpoint, it is postulated that science and people have never been content to be given part truth and knowledge and then forget about it. M.G.J.

N69-14163# Rice Univ., Houston, Tex.

SPACE NEWS STORIES AND PUBLICITY (PANEL DISCUSSION)

Lee Estes *In* NASA. Manned Spacecraft Center Space Sci. Writing at a Down to Earth Level Jan. 1968 p 56–71 (See N69-14157 04-08)

Avail: CFSTI

Several views are offered on the policies which NASA formulated to handle scientific news coverage to accommodate mass media. Consideration is given to such agency problems as preparing for the onslaught of reporters, interviewers, radio and television commentators, and camera equipment and crews. A broadcaster makes the charge that NASA does not sufficiently understand the peculiar needs of radio and television, and the need for technically oriented public affairs officers who are capable of acting as interface between the newsman and the NASA project man. The Gemini 8 flight is given as a classic example of an information gap. The information function of newspapers is discussed with particular stress placed on the lack of pooled coverage in the mission control viewing room. In rebuttal, the point is made that the First Amendment deals with the freedom of the press and its right to acquire information, and that it should be used as a freedom rather than a subpoena. M.G.J.

N69-14164# World Book Encyclopedia Science Service, Inc., Chicago. Science News Service.

SPACE SCIENCE WRITING FOR THE GENERAL PUBLIC

William C. Sexton *In* NASA. Manned Spacecraft Center Space Sci. Writing at a Down to Earth Level Jan. 1968 p 72–77 (See N69-14157 04-08)

Avail: CFSTI

The philosophy of the space program in communicating science information is discussed, and the charge is made that the space program has lost touch with the public, therefore the public has lost interest in the program. The view is offered that prime attention is centered on the manned space flights, with little emphasis placed on the results of scientific research, and the development of information systems and technology which can solve vast problems of social engineering and urban blight. The need for developing simple techniques of communciating is stressed, along with the need for presenting the data in terms familiar to the audience, and in short easy-to-comprehend sentences. M.G.J.

N69-14165*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

GRAPHICS PARTICIPATION IN THE MISSION EVALUATION REPORT AT THE MANNED SPACECRAFT CENTER

Roy Magin *In its* Space Sci. Writing at a Down to Earth Level Jan. 1968 p 78–108 (See N69-14157 04-08)

Avail: CFSTI CSCL 05B

The main objective of a mission evaluation report (MER) is cited as one of assimilating all facts and figures from each mission evaluation and thoroughly documenting them for future reference. The role that graphics and reproduction support services play in these evaluations is described. The basic format is given for the figures which include charts, graphs, photographs, technical illustrations, and combinations of these. The resources employed to meet growing MER requirements are listed as updating existing art, use of math aid plots and machine plots as original art, preprinted maps, photograph–artwork combinations to simplify illustrations, designing preprinted forms to display certain data, planning production of figures with maximum flexibility, and the assignment of one NASA and one contractor graphic coordinator to the MER team. M.G.J.

N69-14166# Federal Electric Corp., Houston, Tex.

INFORMATION RETRIEVAL—DEFINITION AND PERSPECTIVE

John M. Stout *In* NASA. Manned Spacecraft Center Space Sci. Writing at a Down to Earth Level Jan. 1968 p 109–123 (See N69-14157 04-08)

Avail: CFSTI

A descriptive definition of information retrieval is formulated, and it is shown how the various programs of such a system interface with each other to establish an intelligence network. The processing steps are discussed in terms of adequate screening of the input into the system, adequate storage in the system, and effective retrieval from the system. As the type of information needed determines which retrieval system satisfies the requester, consideration is given to micro information (data retrieval), macro information (information retrieval), and document information (document retrieval). The techniques used for retrospective or literature searches are described, along with those used for current awareness or selective dissemination of information. Consideration is also given to the problems involved when a scientist or engineer tries to keep abreast of developments in his particular field. M.G.J.

N69-14167# Houston Univ., Tex.
STYLE IN TECHNICAL WRITING
Louis Alexander *In* NASA. Manned Spacecraft Center Space Sci. Writing at a Down to Earth Level Jan. 1968 p 124–130 (See N69-14157 04-08)
Avail: CFSTI

Several guidelines are proposed as a means of achieving better written and more easily understandable reports. These suggest: (1) Determine what there is about the work that matters to the person for whom it is being written. (2) Draw some conclusions about the work, summarize it, and explain it in terms of what's important to him such as the money, the equipment, and the use to which it can be put. (3) Use the active tense whenever possible. (4) Use short, direct sentences. (5) Avoid using nouns and adjectives to modify a major noun. (6) Use repetition to drive home an idea. (7) Offer explanations as well as facts. M.G.J.

N69-14181*# Pittsburgh Univ., Pa.
ATTRITION IN INFORMATION DISSEMINATION RELATIONSHIPS WITH INDUSTRY
Allen Kent [1968] 43 p
(Contract NSR-39-011-076)
(NASA-CR-98661) Avail: CFSTI CSCL 05B

A study of large and small industries that have received information service from the University of Pittsburgh—NASA Regional Dissemination Center (Knowledge Availability System Center(KASC)) was conducted in an attempt to identify factors which influence these industries to continue or discontinue relationships with the activity. Fifty-one hypotheses were tested statistically in relation to 40 questions that were posed in connection with this study. Only eight hypotheses were supported significantly by statistical evidence and, of these, three are considered interesting. Industries that have continued relationships with the activity have: (1) provided more feedback information to the KASC than those industries that have discontinued; (2) received a higher proportion of relevant responses than those industries that have discontinued the relationship; and (3) had administrative staff of the company negotiate the initial contract in lieu of corporate offices. Unexpectedly, hypotheses relating to the positive effect on contract renewal of frequent contacts, as opposed to impersonal feedback contacts on a periodic basis, were not supported by statistical evidence. Author

N69-14270# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
ASYNCHRONOUS COMPUTATIONAL STRUCTURES
Fred L. Luconi (Ph.D. Thesis) Feb. 1968 148 p refs
(Contract Nonr-4102(01))
(AD-677602; MAC-TR-TR-49) Avail: CFSTI CSCL 9/2

The computational schema is introduced as a means for describing asynchronous computational structures. This mathematically formulated schema provides for the representation of systems in which several asynchronously communicating processes may proceed concurrently while sharing computational resources. Based on the representation scheme, a theory of asynchronous communication has been developed which allows theorems about the processing characteristics of modular systems to be proved. In particular, deterministic system output behavior is related to a set of conditions on subsystem intercommunication. Author (TAB)

N69-14291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTER TECHNOLOGY IN CONTROL ENGINEERING (SELECTED ARTICLES)
1 Dec. 1967 23 p refs Transl. into ENGLISH from the book "Vychislitel'naya Tekhnika v Upravlenii; Trudy Konferentsii" Moscow, Izd-Vo Nauka, 1966 p 70–76, 231–235
(AD-677163; FTD-MT-24-320-67) Avail: CFSTI CSCL 9/2

CONTENTS:
1. ACCURACY OF PROBLEM SOLUTION USING A DDA WITH MONITORING AND CORRECTION Ye. I. Perovskaya p 1–9 refs (See N69-14292 04-08)
2. UNIVERSAL LOGIC OPERATION UNIT FOR SERIAL NODE DIGITAL DIFFERENTIAL ANALYZERS Yu. V. Kovachich p 11–16 refs (See N69-14293 04-08)

N69-14292# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACCURACY OF PROBLEM SOLUTION USING A DDA WITH MONITORING AND CORRECTION [O TOCHNOSTI RESHENIYA ZADACH NA TSDA S KONTROLEM I KORREKTSIYEY]
Ye. I. Perovskaya *In its* Computer Technol. in Control Eng. 1 Dec. 1967 p 1–9 refs (See N69-14291 04-08)
Avail: CFSTI

The accuracy of digital differential analyzers is investigated. The impetus for this work was given by the development of a system for plotting curves with a digital differential analyzer. One method for judging the accuracy of the computations with a digital differential analyzer is to regard the given function as a projection of the intersect of multidimensional surfaces; the correctness of the solution for the simplest one is a measure for the correctness for the solution of the whole problem. Though additional logic is needed to perform this function, the accuracy of the system is improved. Author

N69-14293# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UNIVERSAL LOGIC OPERATION UNIT FOR SERIAL NODE DIGITAL DIFFERENTIAL ANALYZERS [UNIVERSAL'NYY BLOK LOGICHESKIKH OPERATSIY DLYA TSIFROVYKH DIFFERENTSIAL'NYKH ANALIZATOROV POSLEDOVATEL'NOGO DEYSTVIYA]
Yu. V. Kovachich *In its* Computer Technol. in Control Eng. 1 Dec. 1967 p 11–16 refs (See N69-14291 04-08)
Avail: CFSTI

The design and performance of a logic operation block to supplement the inadequate logic operation capacity of serial mode digital differential analyzer is described. The organization of digital differential analyzers is designed for arithmetic, rather than logic operations. Since even a very limited number of logic operations requires the use of a large number of integrators, the latter are diverted from their basic function—integration. Hence, an external supplementary system which would perform the required logic operations would substantially increase the speed and usefulness of a digital differential analyzer. Author

N69-14321# RAND Corp., Santa Monica, Calif.
APAREL—A PARSE-REQUEST LANGUAGE
R. M. Balzer and D. Farber Oct. 1968 38 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-677268; RM-5811-ARPA) Avail: CFSTI CSCL 9/2

A description, without listing, of APAREL, a flexible high-level parsing-language extension to PL/I that provides the pattern-matching capability normally found only in special-purpose languages such as SNOBOL4 and TMG. This capability is provided through parse requests stated in a BNF-like format, which form their own programming language with special sequencing rules. Upon successful completion of a parse request, an associated piece of PL/I code is executed, which has as normal PL/I strings the various elements of the parse (at all levels). It has as normal PL/I variables the information concerning which of the various alternative parsings were successful. Convenient facilities for multiple

input-output streams, the initiation of sequences of parse request as a subroutine, and parse-time semantic checks are included. APAREL has proved convenient in building a powerful SYNTAX and FUNCTION macro system, an algebraic language preprocessor debugging system, an on-line command parser which produces actions rather than machine code, and a translator for Dataless Programming (RM-5290-ARPA), and as a general string manipulator. Author (TAB)

N69-14350# RAND Corp., Santa Monica, Calif.
THE INTEGRATED GRAPHICS SYSTEM FOR THE IBM 2250
Gary D. Brown and Charles H. Bush Oct. 1968 171 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-677464; RM-5531-ARPA) Avail: CFSTI CSCL 9/2

The report is a programmers manual for IGS, the Rand interactive computer graphic software, as implemented on the IBM 2250 graphic hardware. Programmed in FORTRAN IV with special facility for addressing a single character directly, IGS is machine-independent and callable from many languages acceptable to an IBM 360, including PL/I. The 360 can only start or stop the 2250 and read or write into it. The user controls the system through the 2250s online typewriter, light pen, or function keys; or by writing or drawing on the Rand Tablet, if included; or by touching user-defined sensitive areas with the light pen or Tablet stylus. Only parameters of interest need to be specified; IGS automatically provides default values for character size, spacing, line spacing, and other format details. IGS accepts user coordinates and translates them into raster units. It automatically rescales graphical data to fit available space, converts graphical to numerical data, etc. One subroutine draws an entire graph to fit given data, with a single call. The report includes an alphabetical index, a cross-reference index of subroutine calls, and a listing by type, as well as a detailed description of each. Author (TAB)

N69-14376# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANIZATION AND AUTOMATION OF CONTROL (SELECTED ARTICLES)
9 Nov. 1967 11 p refs Transl. into ENGLISH from Mekhaniz. Avtomatiz. Upr., no. 1, 1966 p 13–16
(AD-677692; FTD-HT-23-1412-67) Avail: CFSTI CSCL 9/2

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1. PROGRAM INTERRUPTION WITHIN A MAGNETIC TAPE ACCESS CYCLE V. K. Kuznetsov et al p 1–3 (See N69-14377 04-08)

2. A DEVICE FOR FIXING LIMITING VALUES OF PARAMETERS FOR THE IV-500 INFORMATION COMPUTER G. I. Gil'man, Ye. Ye. Zhukovskiy, and K. M. Chugunov p 4–6 refs (See N69-14378 04-08)

N69-14377# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROGRAM INTERRUPTION WITHIN A MAGNETIC TAPE ACCESS CYCLE
V. K. Kuznetsov et al *In its* Mechanization and Automation of Control 9 Nov. 1967 p 1–3 (See N69-14376 04-08)
Avail: CFSTI

Designed was a program-interrupt unit for use with the Minsk-2 and Minsk-22 computer magnetic tape memory. The program-interrupt unit coordinates the exchange of information between the arithmetic unit and various memory types whose maximum waiting times differ into maximum time during which information may be stored in a memory unit without loss. Since the waiting time for magnetic tape memory is practically infinite and of other units is as the order of tens or hundreds of milliseconds, it is most expedient to interrupt during magnetic tape memory access with subsequent unconditional transfer back to the tape memory. The program and hardware required for this function are described. Author

N69-14378# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DEVICE FOR FIXING LIMITING VALUES OF PARAMETERS FOR THE IV-500 INFORMATION COMPUTER
G. I. Gil'man et al *In its* Mechanization and Automation of Control 9 Nov. 1967 p 4–6 refs (See N69-14376 04-08)
Avail: CFSTI

The memory unit of the IV-500 computer is a non-destructive readout unit with a high signal/noise ratio (15:1) and very little interference between the fields of neighboring bits. The fixing of the values of the parameters recorded in the memory unit is performed by placing permanent magnets next to the cores which are to contain "0"s. The intensity of the magnetic field may be varied over wide limits. These cores are placed in interchangable plug-in panels which are easily removed and replaced, providing program flexibility and easy repair with little or no interruption in computer operation. The memories may be used successfully in centralized control computers. Author

N69-14453# Naval Ordnance Lab., White Oak, Md.
DIRECT FM-TAPE-TO-DIGITAL CONVERSION
Eric K. Pritchard Jul. 1968 52 p refs
(AD-677599; NOLTR-68-106) Avail: CFSTI CSCL 14/3

A direct conversion of FM tape recordings which is entirely digital from the modulator to the approximation function used in computer analysis is described. This system is compared with the usual analog-voltage-to-digital conversion system; the new digital system is almost always better. An extended direct system is discussed; this has almost twice the response and accuracy of the other two systems. Author (TAB)

N69-14468# Stanford Research Inst., Menlo Park, Calif.
HIGH INFORMATION DENSITY STORAGE SURFACES Quarterly Report, 1 Apr.–30 Jun. 1968
L. N. Haynick, ed. Ft. Monmouth, N. J. Army Electron. Command Oct. 1968 47 p refs
(Contract DA-28-043-AMC-01261(E))
(AD-677410; ECOM-01261-13; QR-13) Avail: CFSTI CSCL 9/2

The program is devoted to the preparation and investigation of novel electron-beam-addressable storage mosaics and to the construction of an experimental, large-capacity, high-speed, data-storage system based on the use of such mosaics. Current emphasis is on so-called micro-cap mosaics, the elements of which are discrete, submicron-size capacitors at the bases of regular arrays of closely spaced holes in molybdenum/alumina/molybdenum film sandwiches. Author (TAB)

N69-14493*# Bendix Corp., Baltimore, Md. Communications Div.
DIGITAL FILTERING AND PROCESSING BY TRANSFORM TECHNIQUES. VOLUME 2: DIGITAL FILTER GENERATION AND APPLICATION ROUTINES Final Report
Edgar H. German, Jr. and Knowles Little 30 Jun. 1968 149 p
(Contract NAS8-20308)
(NASA-CR-98191) Avail: CFSTI CSCL 09B

Instructions are presented for the use of these routines without giving a detailed explanation of the underlying mathematics, even though many of the routines implement fairly sophisticated mathematical operations. The routines are designed for a computer with a FORTRAN IV compiler. Two basic types are presented: (1) synthesis or filter coefficient generation routines; and (2) application

or filtering routines. The synthesis routines aid in design of the digital filters, while the applications routines use the filter weights computed by the synthesis routines to perform data filtering. The synthesis routines are treated in some detail due to their complexity, while the applications routines are relatively simple subroutines. Some fundamental applications routines helpful in many problems are included. Statistical filtering routines are not included. K.W.

N69-14557# Siemens A.G., Munich (West Germany).
MAGNETIC COMPONENTS FOR SPACE ELECTRONICS. PART 2 [MAGNETISCHE BAUELEMENTE DER ELEKTRONIK FUER DEN RAUMFLUG, TEIL 2]
P. Henninger Sep. 1968 60 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-61-Pt-2) Avail: CFSTI

The changes due to aging in the permeability of ferrite cores can be predetermined, within a good approximation, under varying operational conditions. The permeability at low magnetizing fields of most materials is reduced by a certain amount by mechanical statical pressure loadings, the degree of the reduction being proportional to the permeability measured in an unloaded condition. Vibration tests, with a maximum acceleration of up to 50 g, on matrix memory cores brought no change in the voltage signals. Irradiation of high and low permeability ferrites with fast neutrons caused a reduction in the permeability and an increase in the change due to aging, while the properties of cores with square-type loops (memory cores) remained practically unchanged. Permanent magnets of strontium ferrite can be stabilized by a single cooling process. A ferrite of high stability, small losses, and a practically linear temperature dependence of permeability over a wide temperature range (−40° to 60° C) was developed for medium frequencies. The pressability of the powder was improved for the production of high-permeability miniature cores. Author

N69-14559# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASSIGNMENT OF RELIABILITY NORMS FOR THE INDIVIDUAL UNITS OF A DIGITAL COMPUTER IN THE INITIAL DESIGN STAGE OF AGREEING ON THE TACTICAL-TECHNICAL DESIGNATION
L. V. Surkov et al 30 Nov. 1967 10 p refs Transl. into ENGLISH from Vysshaye Tekhnol. Uchilishche. Vychislitel'naya Tekhn. (Moscow), no. 5, 1966 p 164–169
(AD-677242; FTD-HT-23-1510-67) Avail: CFSTI CSCL 9/2

Two approaches are analyzed for achieving the efficient assignment of reliability norms to the various units of a digital computer, e.g., the arithmetic unit (AU), the control unit (CU), and the main memory unit (MU). The problem consists in finding the failure rate of these units which will satisfy a given probability of machine failure Q(T) in time T. In the first approach the approximate failure rates are expressed as functions of the complexity of units and the relative failure rates of the components. A more realistic view of the failure rates of the units must take into account their manufacturing and operating costs. The authors derive an expression for finding the failure rate of individual units for which the cost of a unit is minimum taking into account the cost of the entire computer complex. TAB

N69-14560# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROL AND DIAGNOSTICS OF FAULTS IN A REDUNDANT DIGITAL COMPUTER CONSTRUCTED ON THE MAJORITY PRINCIPAL
E. M. Mamedli 30 Nov. 1967 11 p refs Transl. into ENGLISH from An AzerbSSR. Izv. Ser. Fiz.-Tekhn. i Mat. Nauk, no. 1, 1966 p 58–62
(AD-677694; FTD-HT-23-1507-67) Avail: CFSTI CSCL 9/2

Majority redundance to increase the reliability of a control computer is effected by breaking up the computer into S equally reliable blocks, at the level at which the redundance is introduced. The number of redundant blocks (R) may or may not be equal to the number of functional blocks (M). An expression is given for the reliability of the redundant computer with allowance for the fact that in practice it is impossible to subdivide the computer into blocks of equivalent reliability. The monitoring of faults in such a redundant computer is based on the fact that in the case when all the functional and majority elements operate correctly, the outputs of the redundant networks should have identical states. Any disagreement between the outputs of the redundance blocks can be described by a certain function made up of two-threshold functions, each of which can be realized by a single two-threshold element. A block diagram for the monitoring of the computer, based on this principle, is presented. TAB

N69-14621# Michigan Univ., Ann Arbor.
FEASIBILITY OF A SET THEORETIC DATA STRUCTURE. A GENERAL STRUCTURE BASED ON A RECONSTITUTED DEFINITION OF RELATION
David L. Childs Aug. 1968 44 p refs Presented at the IFIP Congr. 1968, Edinburgh, 6 Aug. 1968
(Contract DA-49-083-OSA-3050; ARPA Order 716; Proj. Concomp)
(AD-677053; TR-6) Avail: CFSTI CSCL 5/2

The paper is motivated by an assumption that many problems dealing with arbitrarily related data can be expedited on a digital computer by a storage structure which allows rapid execution of operations within and between sets of datum names. In order for such a structure to be feasible, two problems must be considered: (1) the structure should be general enough that the sets involved may be unrestricted, thus allowing sets of sets of sets...; sets of ordered pairs, ordered triples...; sets of variable length n-tuples, n-tuples of arbitrary sets; etc.; (2) the set-operations should be general in nature, allowing any of the usual set theory operations between sets as described above, with the assurance that these operations will be executed rapidly. A sufficient condition for the latter is the existence of a well-ordering relation on the union of the participating sets. These problems are resolved in this paper with the introduction of the concept of a complex which has an additional feature of allowing a natural extension of properties of binary relations to properties of general relations. Author (TAB)

N69-14680# Northwestern Univ., Evanston, Ill. Technological Inst.
A DECOMPOSITION METHOD FOR INTERVAL LINEAR PROGRAMMING
Phillip D. Robers and Adi Ben-Israel Aug. 1968 24 p refs *Its* Systems Res. Mem. No. 216
(Contracts DA-31-124-ARO(D)-322; Nonr-1228(10); N00014-67-A-0356-0008; Grant NSF GP-7550)
(AD-677101) Avail: CFSTI CSCL 12/2

An interval linear program is (IP) maximize $(c^{sup}t)x$, subject to $b^- \le Ax \le b^+$ where the matrix A, vectors b^-, b^+, and c are given. If A has full row rank, the optimal solutions of (IP) can be written explicitly (A. Ben-Israel and A. Charnes: An explicit solution of a special class of linear programming, Operations Research, forthcoming). This result is used in conjunction with the Dantzig-Wolfe decomposition principle to develop a finite iterative technique specially suited for solving the general (IP). Since any bounded linear program may be cast in form (IP) the technique may also be considered as an alternate method for linear programming. Author (TAB)

N69-14743# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MACHINE RECOGNITION OF HANDWRITTEN NUMBERS

V. M. Trufus et al. 20 Dec. 1967 9 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst., no. 85, 1964 p 80–86

(AD-677217; FTD-HT-23-1075-65) Avail: CFSTI CSCL 6/4

A method of recognition of handwritten digits according to elements of shape is described. The sign of the first derivative of a number element is taken as the principal distinguishing feature. The breakdown of a number into elements and the determination of the signs of the first derivative are accomplished with the aid of an electron-optical device moving the image of the number in front of a stack of photocells. The received information is automatically compared with the standard and the number is determined. A block diagram of the device and the levels of the algebra of logic describing the logic elements of the system are presented. When a P13 type semiconductor triode is used in the logic circuits, the electronic part of the device assures a readout rate of 35,000 digit signs per sec. Author (TAB)

N69-14748# Illinois Univ., Urbana. Dept. of Computer Science.

COMPUTER SYSTEMS RESEARCH Annual Report, 1 Sep. 1967–31 Aug. 1968

C. W. Gear and W. J. Poppelbaum Jun. 1968 32 p refs

(COO-1469-79) Avail: CFSTI

The graphic programming system using a remote graphic terminal on the ILLIAC II time-sharing system is described. Implementation of the numerical section for automatic integration of ordinary differential equations is briefly discussed. Also, development of the two advanced hybrid systems, the Tri-Color Cartograph and the Information Redistribution Bandwidth Compression is outlined. It has effectively become possible to color regions of a tri-color tube by pointing a light pen, and it has also become possible to reduce the bandwidth in the transmission of line drawings with less than 32 elements by a factor of over 10 without loss of definition. NSA

N69-14766*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

INVESTIGATION OF COINCIDENT RADIO-FREQUENCY DRIVE FOR NONDESTRUCTIVE READOUT IN THIN-FILM MEMORIES Final Report

W. Stewart Nicol Sep. 1968 80 p refs

(Grant NsG-496; Contract AF 33(657)-11311)

(NASA-CR-98747; ESL-FR-361) Avail: CFSTI CSCL 09B

An investigation of the feasibility of applying radio-frequency drive techniques to a nondestructive readout (NDRO) thin magnetic film memory is described. The method was demonstrated as being very successful in obtaining coincident-frequency NDRO. Drive currents of 20 MHz and 40 MHz were used during readout, when it was observed that values for these currents as low as 30 mA peak-to-peak with 20-mil wide drive lines still gave discernible output signals. Coincident radio-frequency writing was found to be possible only under critical phase and bias conditions, being limited by domain boundary creep and noncoherent magnetization rotation. Author

N69-14833# National Environmental Satellite Center, Washington, D. C.

NESC DIGITAL FORMATTING SYSTEM (DFS)

Randall G. Hill Sep. 1968 21 p

(NESCTM-5) Avail: Issuing Activity

A high-volume, computer-controlled, data-formatting system is described. The system digitizes and formats the several types of data, both direct and stored, from ESSA spacecraft. System inputs are frequency modulated (FM) subcarriers from the spacecraft sensors, relayed to NESC over microwave links from Command and Data Acquisition Stations. System outputs are digital magnetic tapes used to interface with a large-scale computer. Author

N69-14835# Notre Dame Univ., Ind. Dept. of Electrical Engineering.

A UNIFIED MARKOVIAN ANALYSIS OF DECODERS FOR CONVOLUTIONAL CODES

Thomas N. Morrissey, Jr. 24 Oct. 1968 108 p refs

(Grant NGL-15-004-026)

(NASA-CR-98709; EE-687) Avail: CFSTI CSCL 09B

Previous analyses of the error probability for feedback decoding of convolutional codes have focused almost exclusively upon the *syndrome portion* of the decoder, the contents of which are statistically dependent upon the infinite past due to the feedback of previous decoding estimates. In this paper, however, the *entire decoder* is modeled as an autonomous stochastic sequential machine and finite Markov chain theory applied in order to obtain a precise expression for $P_{FD}(u)$, the probability of error associated with the feedback decoding of the u^{th} subblock of information digits, thus circumventing the problems imposed by the dependencies on the infinite past. The analysis technique developed here applies to any syndrome feedback decoder for a systematic, rate $R = K/N$ convolutional code of memory order m over GF(2), used for transmission over a binary symmetric channel. Author

N69-14887# Technische Hogeschool, Delft (Netherlands).

SPECIAL PURPOSE COMPUTERS FOR ON-LINE DETERMINATION OF CORRELATION FUNCTIONS AND POWER DENSITY SPECTRA WITH SYNCHRONOUS AND ASYNCHRONOUS INPUT SIGNALS

B. P. T. Veltman *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 97–159 (See N69-14878 04-22) refs

Avail: CFSTI

A relatively cheap computing device is described to be used with on-line statistical measurements with very low (0.001 Hz) and high (2 MHz) frequency signals. The instrument is able to calculate polarity-, relay- and quantized correlation functions, either directly to 128 points or by acoustical delay lines up to 1000 points. A hybrid Fourier transform computer calculates auto-, and crosspower density spectra with a speed of 40 points per second. Both measuring instruments are demonstrated. Author (ESRO)

N69-14940# European Space Technology Center, Noordwijk (Netherlands).

DATA HANDLING IN THE DIVISION OF ENVIRONMENTAL TESTING AT ESTEC [LE TRAITEMENT DES DONNEES DANS LA DIVISION DES ESSAIS D'AMBIANCE DE L'ESTEC]

P. E. Muller *In* ESRO ESRO/ELDO Bull. No. 2 Aug. 1968 p 18–20 In French (See N69-14937 04-34)

Avail: CFSTI

The processing of data deduced from vibrational tests, materials and component tests, thermal measurements made in space chambers and magnetic measurements made on satellites is described. ESRO

N69-14971# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

ON SOME NONSTANDARD SEMI-INFINITE PROGRAMMING PROBLEMS

K. O. Kortanek (Cornell Univ., Ithaca, N. Y.), A. Charnes (Northwestern Univ.), and W. W. Cooper Mar. 1968 26 p refs

(Contract Nonr-760(24))

(AD-673968; RR-139) Avail: CFSTI CSCL 12/2

Aspects of the duality theory for semi-infinite programming are here extended to fields with properties of non-archimedean order. Emphasis is on nonstandard semi-infinite programming problems in Hilbert's field. The ideas of regularization are generalized to include powers of the relative infinites in terms of the indeterminates. Author (TAB)

N69-14981# Stanford Univ., Calif. Dept. of Computer Science.
REPROCESSING FOR SPEECH ANALYSIS
Pierre Vicens 11 Oct. 1968 35 p refs
(Contract ARPA SD-183)
(AD-677520; SU-AI-71) Avail: CFSTI CSCL 17/2

The paper describes a procedure, and its hardware implementation, for the extraction of significant parameters of speech. The process involves division of the speech spectrum into convenient frequency bands, and calculation of amplitude and zero-crossing parameters in each of these bands every 10 ms. In the software implementation, a smoothing function divides the speech spectrum into two frequency bands (above and below 1000 Hz). In the hardware implementation, the spectrum is divided into three bands using bandpass filters (150-900 Hz, 900-2200 Hz, 2200-5000 Hz). Details of the design and implementation of the hardware device are given. Author (TAB)

N69-14983# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Jun.-31 Aug. 1968
John H. Munson Nov. 1968 22 p
(Contract DA-28-043-AMC-01901(E))
(AD-677391; ECOM-01901-32; Rept-32; QR-10) Avail: CFSTI CSCL 9/2

These Quarterly Reports describe the continuing development of scanning, preprocessing, character-classification, and context-analysis techniques for handprinted text, such as computer coding sheets in the FORTRAN language. During the period of this report, our effort was directed toward preparations for the delivery of the MINOS III facility. This effort included the development of a diagnostic program and operating program for the facility, software and hardware documentation, and the creation of a link allowing the computer to output quantized character images to the 1024-image preprocessor. This link is described in some detail. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N69-13930# Joint Publications Research Service, Washington, D. C.
ENGINEERING FUNDAMENTALS OF THIN-FILM MICROELECTRONICS
Nikita Konstantinovich Ivanov-Yesipovich 9 Dec. 1968 172 p refs Transl. into ENGLISH of the book "Inzhenernyye Osnovy Plenochnoy Mikroelektroniki" Leningrad, Energiya Publ. House, 1968 174 p
(JPRS-47039) Avail: CFSTI

This book contains an investigation of applied technological problems in the manufacture and design of thin film microcircuits constituting a further improved development of printed circuit engineering. The conditions of obtaining the thin film resistive, capacitive, triode and diode components forming the general pattern of the microcircuit are studied. Significant attention is given to the process of manufacturing thin-film field triodes with an insulated gate, ensuring accuracy in obtaining and aligning patterns of different layers, execution of film contacts with external leads and analysis of the vacuum process conditions for obtaining thin film microcircuits which do not contain mounted parts. Author

N69-13933# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
IRRADIATION EFFECTS ON SEMICONDUCTOR DETECTORS AND COMPONENTS
L. D. Philipp and N. C. Holtink *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 15-19 refs (See N69-13931 04-14)
Avail: CFSTI

The operating characteristics of semiconductor devices such as field effect transistors and diode detectors must be known to accurately predict circuit/detector operation in ionizing radiation environments. During irradiation of metal-oxide-semiconductor (MOS) transistors, a positive charge builds up in the surface oxide layer and surface states are introduced which change the operating characteristics of the device. Irradiation of 33 devices, representing 3 types of units, in the ^{60}Co gamma facility demonstrated that radiation resistance can be improved by proper selection of device types and operating point. Author (NSA)

N69-13937# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
SURFACE CONTOURED DIODE APPLICATIONS
K. L. Swinth *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 41-43 refs (See N69-13931 04-14)
Avail: CFSTI

The availability of surface contoured diodes for use as charge multiplication detectors of low energy X rays, permits new approaches to improved plutonium wound counting techniques. Although the diodes evidence low detection efficiencies, their small size and low background count rates offer some advantage over more conventional approaches. To date, several different configurations, including a hypodermic needle probe, have been investigated for possible use. Advancing technology will produce a variety of possible applications as better units become available. Author (NSA)

N69-14117# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
THE INTERACTION OF TWO FREQUENCY-MODULATED OSCILLATORS
Raymond C. Johnson, Jr. 13 Aug. 1968 113 p refs
(Contract DAAG39-67-C-0077)
(AD-677404; SR-68-4; HDL-0077-10) Avail: CFSTI CSCL 9/5

The interaction effects of two frequency modulated oscillators are derived and justified with numerous experimental waveforms. A step-by-step word and picture explanation is presented--starting from the interference waveform of a CW signal coupled to a compliant CW oscillator and ending with the interaction signature of two coupled frequency modulated oscillators. It is shown that the interaction signature for two frequency modulated oscillators can be easily obtained from knowledge of the lock-in pattern of the two when unmodulated, by using a simple graphical procedure. Author (TAB)

N69-14247# Siemens A.G., Munich (West Germany). Wernerwerk fuer Bauelemente.
MAGNETIC COMPONENTS FOR SPACE ELECTRONICS, PART 1 [MAGNETISCHE BAUELEMENTE DER ELEKTRONIK FUER DEN RAUMFLUG, TEIL 1]
P. Henninger et al Bundesmin. fuer Wiss. Forsch. Sep. 1968 54 p refs In GERMAN; ENGLISH summary
(BMwF-FBW-68-60) Avail: CFSTI

By suitable mechanical measures the influence of mounting, cementing, potting and adjusting arrangements on the properties of pot-core coils can be largely reduced. Vibration tests on pot-core coils with an acceleration of 50 g reveal that inductance and Q-factor variations are smallest with a compact coil design. The

reduction in permeability observed on ferrites of high permeability upon radiation with neutrons and protons is most marked in the temperature range between the secondary permeability maximum and minimum; after heating to 128°C part of such radiation damage is repaired. For use within temperature ranges down to −50°C transformer ferrites with permeabilities exceeding 10 000 as well as ferrites for tuned-circuit coils with low losses and high stability have been developed. Particularly high coercive field strengths can be attained with new strontium-ferrite permanent magnets; these ensure low sensitivity to demagnetizing fields. Author

N69-14256*# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH AND DEVELOPMENT OF A SINGLE GUN COLOR CRT, PHASE 1 Final Report
Thomas E. Sisneros, Paul A. Faeth, and Joseph A. Davis Washington NASA Dec. 1968 72 p refs
(Contract NAS12-534)
(NASA-CR-1228) Avail: CFSTI CSCL 09A

The feasibility of producing cathode-ray tubes which have a current density-dependent color variation at constant accelerating voltage has been demonstrated. The screens for these tubes were prepared by combining superlinear phosphors with linear or sublinear phosphors. The preparation of phosphors having a superlinear intensity versus current density behavior was studied. Phosphors having superlinear behavior in the current density range normally used for CRT operation were prepared by partially poisoning (ZnCd)S:Ag with a few ppm of Ni. A number of experimental screens and tubes were prepared utilizing various combinations of experimental phosphors. Color shifts from reddish-orange to yellow and from yellowish-green to yellow to orange have been obtained. Author

N69-14265# Institute of Nuclear Research, Warsaw (Poland).
NON-OVERLOADING LINEAR PULSE AMPLIFIER
Ryszard Bayer and Teresa Koba 1968 19 p refs In POLISH; ENGLISH summary
(INR-917) Avail: CFSTI

A non-overloading linear pulse amplifier was built. Its operation principle, solution and characteristics are described. Some results of measurements are given. Author (NSA)

N69-14297*# Martin Co., Orlando, Fla.
ADVANCED CONTROL SIGNAL PROCESSOR, PHASE 3 Completion Report
W. B. Towles Feb. 1967 77 p ref
(Contract NAS8-11684)
(NASA-CR-98204; OR-8722) Avail: CFSTI CSCL 09E

This report covers work accomplished during Phase 3 of the development of a prototype of an Advanced Control Signal Processor (ACSP). The major portion of Phase 3 was concerned with environmental tests consisting of temperature, EMI, leakage, vibration, shock, and acceleration tests. Author

N69-14319 Pittsburgh Univ., Pa.
ANALYSIS OF SEMICONDUCTOR DEVICES BY MEANS OF NUMERICAL FIELD PLOTTING TECHNIQUES
Robert Allen Lester (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms; HC $7.00/Microfilm $3.00 Order No. 68-6120

The analysis of semiconductor devices has, for the most part, been restricted to the study of one-dimensional models. This thesis is an investigation of the feasibility of using computer-numerical techniques to determine the time variation of the electric fields and carrier densities within two-dimensional models of semiconductor devices. Difference equations are developed which describe the internal fields of semiconductors and specific iteration techniques to be used for the solution of these equations are recommended. It is demonstrated that numerical-iterative techniques may be advantageously applied to most areas of semiconductor device analysis and that the techniques yield information which is not easily obtainable by other methods. Dissert. Abstr.

N69-14343*# Martin Co., Orlando, Fla.
ADVANCED CONTROL SIGNAL PROCESSOR Phase 4 Completion Report
W. B. Towles Feb. 1967 64 p
(Contract NAS8-11684)
(NASA-CR-98202; OR-8751) Avail: CFSTI CSCL 09E

The closed loop Advanced Control Signal Processor (ACSP) is a triple redundant system consisting of three identical channels (or groups) that supply all power and signal processing necessary for operation of the rate integrating gyros. Functional descriptions of the operation of each circuit type are illustrated by simplified block diagrams. Schematic diagrams and test results are provided for the basic circuits. All circuits are designed to operate well within their required performance specifications over a temperature range of −55°C to +125°C. The achievement of this design objective is indicated by the test results included in this report. Even though the power supply output voltages are very stable with respect to line, load, and temperature variations, the circuits have been designed to be relatively insensitive to wide variations in power supply voltages for an additional margin of safety. Author

N69-14353# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A STATE OF THE ART SURVEY OF LOW-LEVEL MULTIPLEXERS
R. E. Mahan Sep. 1968 38 p refs
(Contract AT(45-1)-1830)
(BNWL-838) Avail: CFSTI

A comprehensive survey of the state-of-the-art in low-level multiplexers is presented. The study includes a literature search and a theoretical investigation followed by laboratory testing of equipment to support the theoretical investigation. The end result is intended to provide support for the preparation of a systems design description for the FFTF Central Control and Data Handling System. Electromechanical, FET, bipolar transistor, and amplifier-per-channel multiplexers are evaluated. NSA

N69-14380 Iowa State Univ. of Science and Technology, Ames.
NUMERICAL TECHNIQUES APPLIED TO THE INVESTIGATION OF THE DYNAMIC RESPONSE OF A FOUR LAYER DIODE
Ronald John Schmitz (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms; HC $5.20/Microfilm $3.00 Order No. 68-5983

The purpose of this thesis is to develop a mathematical model of a class of four layer semiconductor devices that is controllable for both turn-on and turn-off by a pulse of current applied to one of the two base regions of the device. The model will permit the exploration of the dependence of the switching response on the device geometry and physical constants of the material. The model takes into account the two-dimensional nature of the minority carrier distribution, conductivity modulation, and certain other high-injection level effects. The bias conditions are calculated for the various junctions by a charge analysis approach. The amount of base current applied over an increment of time Δt is calculated so that the amount of charge available for changes in the base region is known which allows the calculated of junction voltages at the end of the time increment Δt. These values of voltages give the boundary conditions for solution of the continuity equation for the two base regions. Dissert. Abstr.

N69-14418 Michigan Univ., Ann Arbor.
MICROWAVE CIRCUIT CONSIDERATIONS FOR BULK GaAs OSCILLATORS
Delon Calvin Hanson (Ph.D. Thesis) 1967 232 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.00 Order No. 67-15631

The purpose of this study is to investigate the microwave circuit characteristics of bulk GaAs transferred electron oscillators. A small-signal, nonisothermal, space-charge-wave device analysis is developed and the dyadic Green's function method is used to analyze the radiation impedance of a wave-guide-coaxial microwave circuit containing the GaAs oscillator. The equivalent circuit of bulk transit-time oscillators is evaluated experimentally and compared with the theoretical device impedance. Additional large-signal bulk modes of oscillation are investigated experimentally using the known circuit impedance at the frequencies of oscillation. In general, the results provide a better understanding of the various modes of oscillation which may occur in bulk GaAs transferred electron devices and are useful in determining the microwave circuit impedance characteristics and bias conditions which are needed to sustain a particular mode of oscillation. Dissert. Abstr.

N69-14431# Siemens A.G., Munich (West Germany).
ELECTRONIC MICROCIRCUITS FOR SPACE APPLICATIONS, PART 1 [BAUGRUPPEN DER ELEKTRONIK FUER DEN RAUMFLUG, TEIL 1]
P. Henninger Sep. 1968 123 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-58-Pt-1) Avail: CFSTI

This paper deals with high-reliability miniature modules. The Simiblock system enables conventional components to be combined. The conductor network applied to two opposite sides allows relatively large and complicated circuits. As a further step towards miniaturization, thin film circuits are described using a vapor deposition technique in a high vacuum without intermediate ventilation for depositing conductors, resistors, and dielectrics of high reliability. Thin magnetic films also produced in the high vacuum are outstanding for their very short switching times. Conductors, resistors and dielectrics of integrated tantalum thin film circuits are produced by chemical or electrochemical secondary treatment of sputtered tantalum films. Author

N69-14445# Stanford Univ., Calif. Stanford Linear Accelerator Center.
AN ANALYSIS OF TRANSIENTS IN TUNNEL-DIODE CIRCUITS
Arpad Barna Aug. 1968 46 p ref
(Contract AT(04-3)-515)
(SLAC-88) Avail: CFSTI

An analysis is performed for the transient response of a tunnel-diode modeled by a circuit of two capacitances, an inductor, and the dc i-v characteristic of the diode. The nonlinear differential equations of the transition are solved numerically, and waveforms are presented for a wide range of circuit parameters. Author (NSA)

N69-14454# United-Carr, Inc., Watertown, Mass. Exploratory Development Lab.
AN ULTRAMINIATURE PLATED COAXIAL CABLE
R. L. Komack Dec. 1968 16 p refs Presented at the 17th Ann. Wire and Cable Symp., Atlantic City, N. J., 4-6 Dec. 1968
(AD-677595) Avail: Issuing Activity CSCL 9/1

The overall diameter of this cable is only .01 inches. Its outer conductor consists of a solid film of deposited copper .001 inches in thickness. The cable can be made in long, continuous lengths. The cable utilizes no threads for flexibility enhancement. The center conductor of this cable is composed of a single strand of AWG no. 42 wire. The base material (Phelps Dodge Alloy no. 195) is plated with 125 microinches of pure gold. The center conductor is coated with FEP Teflon to an overall diameter of .0084 inches. Author (TAB)

N69-14464# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
THE APPLICATION OF PHOTOLITHOGRAPHIC TECHNIQUES TO THE DOPING OF SEMICONDUCTORS BY ION IMPLANTATION
D. N. Osborne Jun. 1968 10 p refs
(AERE-R-5631) Avail: CFSTI

A description is given of a photolithographic process for producing etched device patterns in SiO_2 and/or metal layers on silicon, which are suitable for masking purposes in relation to the ion-implantation doping of the silicon for application in microelectronic devices. Author (NSA)

N69-14603# Brookhaven National Lab., Upton, N. Y.
STATE OF THE ART OF LOW NOISE AMPLIFIERS FOR SEMICONDUCTOR RADIATION DETECTORS
Veljko Radeka [1968] 28 p refs Presented at Intern. Symp. on Nucl. Electron., Versailles, France, 10-13 Sep. 1968 Supported in part by AEC
(BNL-12798; CONF-680906-4) Avail: CFSTI

The state of the art of charge amplifiers with respect to noise, rise time, gain linearity, and response is determined by the field-effect transistors, by the high-frequency bipolar transistors, by the feedback (bias) resistor, and by the dielectrics in the input circuit. A condensed discussion of the relations between amplifier properties and parameters of these devices is presented. Special attention is given to identification of various noise sources. Some data on field-effect transistors, resistors and dielectrics are given. Simultaneous achievement of low noise, high speed, linearity, dynamic range and a well defined time response is considered. A rise time of 15 nanoseconds was obtained with a detector capacitance of 50 pF. A short rise time of this order of magnitude is of interest for timing and for studies of charge collection processes in semiconductor detectors. A method is given for measurement of gain nonlinearity under simulated conditions of high pulse rate. It is shown that the gain nonlinearity is related to the rise time. Author (NSA)

N69-14892# General Electric Co., Schenectady, N. Y. Research and Development Center.
THIN-FILM MEMORY DIODE
John R. Richardson, Robert N. Hall, and James F. Richette Oct. 1968 40 p refs
(Contract F19628-68-C-0158)
(AD-677714; AFCRL-68-0488; SR-1) Avail: CFSTI CSCL 9/1

This report describes further research on the Thin-Film Memory Diode. Improvements in instrumentation have been made which have resulted in much better control and reproducibility. Previous difficulties that had been encountered in making evaporated metal film contacts to the tellurium counterelectrode have been overcome. Good switching characteristics can now be obtained with evaporated film electrodes instead of metal probe contacts to the tellurium. Preliminary tests show that these diodes are tolerant to a slow neutron flux of at least 10 to the 14th power n/cm/sq cm, as well as to over 7,000,000 of cobalt 60 gamma irradiation. Memory arrays having either destructive or nondestructive read-out have been designed, and preliminary steps for the construction of such memory arrays are underway. Author (TAB)

N69-14700*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
MICROMINIATURE HIGH LEVEL MULTICODER Final Report
25 Nov. 1966 44 p
(Contract NAS9-4468; Proj. 3114)
(NASA-CR-92434) Avail: CFSTI CSCL 09E

A reliability analysis is presented for the microminiature high level multicoder, with failure rates computed for both 80° and 160° F which is the maximum operating temperature of the equipment. Specification levels, worst performance at any temperature, and typical performance at room temperature (80° F) are given. The results indicate total electrical compliance at all temperatures. The multicoders meet both size and weight requirements and also performed satisfactorily during the following qualification tests: electromagnetic interference and susceptibility, temperature, altitude, shock, vibration, and acceleration. Because of a sealing problem, compliance during humidity and salt fog was not demonstrated. Author

N69-14713*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
THIN-FILM ACTIVE DEVICE INVESTIGATIONS. Final Status Report, 1 Dec. 1967–31 Aug. 1968
W. S. Nicol Sep. 1968 16 p refs
(Grant NGL-22-009-019; MIT Proj. DSR-76152)
(NASA-CR-98700; ESL-SR-368) Avail: CFSTI CSCL 09A

Work was concentrated on evaporated gallium arsenide with the aim of determining electrical and structural transport properties necessary for a coplanar-electrode, space-charge-limited triode. Both amorphous and single-crystal substrates were used. Differences in results from those obtained by other investigators led to two subsidiary investigations into methods for thermoelectric power measurements and for substrate temperature measurement. Although definitive film properties for active devices were not determined, the results of these investigations should be of interest in any future work in this area. Author

N69-14723# California Univ., Livermore. Lawrence Radiation Lab.
GASEOUS SUBLIMATION PRODUCTS OF SILICON MONOXIDE
E. S. Chambers, E. L. Lee, and R. D. Morrison 17 Jul. 1968 12 p refs
(Contract W-7405-ENG-48)
(UCRL-50469) Avail: CFSTI

In an experiment, designed to examine the vapor composition from a typical silicon monoxide evaporation source, commercial silicon monoxide was sublimed from a resistively heated tantalum box (Mathis boat) with a small exit hole. The vapor beam passed through the ionizer of a quadrupole mass analyzer. In the 1200 to 1550°K range, ion currents were measured for Si^+, Si^+_2, O^+_2, SiO^+, $(SiO)^+_2$. The effusion rate of the sample was obtained by weighting the condensed vapor from the beam. From this and kinetic theory, the total vapor pressure of the sample was calculated, and thermochemical parameters were then calculated for the various species. A large discrepancy was found between the experimental and calculated pressures for the reaction $2\ SiO(g) = Si(g) + SiO_2(g)$. Author (NSA)

N69-14757# Siemens A.G., Munich (West Germany).
ELECTRONIC MICROCIRCUITS FOR SPACE APPLICATIONS, PART 2 [BAUGRUPPEN DER ELEKTRONIK FUER DEN RAUMFLUG, TEIL 2]
P. Henninger Sep. 1968 70 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-59) Avail: CFSTI

The combination of integrated semiconductor circuits into simi blocks results in reliable rigid functional groups of a very high module density. High vacuum systems for research into, and development of, thin-film circuits permit various layers to be evaporated without interruption of the vacuum. An electric trimming method serves to adjust the thin-film resistors. The magnetic properties of thin permalloy layers were examined as a function of the layer thickness. Storage plates turned out to be very resistant to high-energy radiation. The examination of the tantalum layers for thin-film circuits were concentrated especially on problems of the β tantalum as well as on the influence of residual gases. Preliminary treatment allowed the constancy of tantalum thin-film resistors to be improved considerably. Author

N69-14765*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
COMPUTER AIDED ELECTRONIC CIRCUIT DESIGN Status Report, Dec. 1, 1967–May 31, 1968
J. V. Harrington Sep. 1968 24 p refs
(Grant NsG-496)
(NASA-CR-98701; ESL-SR-363) Avail: CFSTI CSCL 09E

Research in on-line circuit design was pursued along a number of directions, centering on the effective use of present and projected on-line utilities in the design of electrical networks and systems. This work may be divided into two broad categories: research in the mathematical foundations of computer-oriented network and system analysis and the interactive features essential for the design of networks and systems. Progress has been made in the development of CIRCAL-II, and in particular on the development of the CIRCAL-II data structure; in a recursive approach for the computer analysis of nonlinear networks; in answering the question "when and how should a network be torn in order to reduce the necessary computational effort"; and in the development of LOTUS, an on-line program for the simulation of block-diagram systems. Author

N69-14784# Royal Aircraft Establishment, Farnborough (England).
ELECTRONIC CIRCUITS IN A SAMPLED DATA ADAPTIVE CONTROL SYSTEM
J. B. Elliot May 1968 33 p refs
(RAE-TR-68133) Avail: CFSTI

A single axis self-adaptive control system (pitch-rate maneuver demand system) for aircraft control has been developed, consisting of analog to digital converters, a counter controlled digital sampling system, a gain change logic and integrator circuit to provide output to the servo system. ESRO

N69-14789# Raytheon Co., Waltham, Mass. Research Div.
CHEMICAL VAPOR DEPOSITED MATERIALS FOR ELECTRON TUBES Triannual Report, 15 Apr.–14 Aug. 1968
S. R. Steele, J. Papis, H. Schilling, and J. Simpson Nov. 1968 43 p refs *Its* 2nd Triannual Rept.
(Contracts DAAB07-68-C-0156; DA-28-043-AMC-01343)
(AD-677412; S-1105; REPT-11) Avail: CFSTI CSCL 9/1

The combined techniques of chemical vapor deposition and photocopying offer the promise of new and useful slow-wave structures for microwave tubes. These slow-wave structures include conventional periodic structures such as the helix, meander line and interdigital line. In addition, structures based upon an anisotropic sheath are possible. These may be superior to single periodic structures in cases where a uniform dc boundary is desirable, or dielectric charging is a problem, or special control of spatial harmonics is desirable. Also, these are the types of structures that result if low loss bulk anisotropic materials are found. Author (TAB)

N69-14783# Army Electronics Labs., Fort Monmouth, N. J.
FIRING CHARACTERISTICS OF MULTIPLE-ELECTRODE TRIGGERED VACUUM GAPS
Sol Schneider, Anthony J. Buffa, and John E. Creedon Oct. 1968 15 p refs
(AD-677381; ECOM-3025) Avail: CFSTI CSCL 9/1

The design of a multiple-electrode triggered vacuum gap for 350-kilovolt operation as an energy diverter was described at the Ninth Modulator Symposium. This program was continued. In the design of the new tubes, the primary design objective was to achieve minimum firing times without sacrifice of voltage hold-off reliability. The arc length was considerably shortened and the ceramic sidewalls have been shielded from the arc. Three different designs were constructed. They are a six-gap tube, a three-gap tube, and a modified version of the three-gap tube with a hydrogen reservoir added. The firing characteristics of these tubes were studied from 1 kilovolt to 280 kilovolts. The influence of a low pressure of hydrogen on firing and hold-off was evaluated. Author (TAB)

N69-14910*# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
THERMIONIC CATHODE EVALUATION STUDY Interim Report, 1 Jul.–30 Sep. 1968
F. T. Hill 31 Oct. 1968 26 p Prepared for JPL
(Contracts NAS7-100; JPL-951810)
(NASA-CR-98692; PT-2042; IR-5) Avail: CFSTI CSCL 09A

During this period of thermionic-cathode evaluation, diodes rising pore-dispenser cathodes have completed at least 8580 hours of life burning and are operating satisfactorily at cathode temperatures of 950° C to 1100° C and at current densities of 0.2A/cm^2 to 1.6A/cm^2. Diodes using standard barium-strontium oxide cathodes have completed life burning times varying from 5238 to 7368 hours. The diodes are showing cathode emission slump at current densities above 0.16A/cm^2 and cathode temperatures of 825° C to 850° C under T_3 and T_4 operating conditions. Author

N69-14969#
DELAY LINES WITH FAST-RESPONSE CONTROL
Iu. D. Bakulin and A. N. Svenson [1968] 4 p refs Transl. into ENGLISH from the book "Elem. Sistem Otbora i Pered. Inform." Kiev, 1965 p 9–13
Avail: CFSTI

Evaluated are fast response control lines to change the time scale of signals by shift register type or by transient compensator. The first system processes signals at a rate in proportion to the change in the instantaneous frequency of the shift pulses and the second system stores the incoming signal and converts each signal element by just one pair of keys. Total signal distortions in the latter system are small but the number of readout commutators has to equal the number of line outputs. The diagram of a register delay line executed by the first method is shown and experimental data for a line made with vacuum tubes are given. G.G.

N69-14994*# Sperry Rand Research Center, Sudbury, Mass. Research Center.
AN INVESTIGATION OF THE EFFECTS OF RADIATION ON SILICON NITRIDE INSULATED GATE (MNS) TRANSISTORS Final Report
H. A. R. Wegener, R. Frank, and F. Sewell May 1968 57 p refs
(Contract NAS5-10223)
(NASA-CR-98739; SRRC-CR-67-65) Avail: CFSTI CSCL 09A

Early data taken indicated IGFETs using silicon nitride as the gate dielectric were more radiation resistant than IGFETs using silicon dioxide as the gate dielectric. A program was initiated to study empirically the effects of various processing steps on the changes in device parameters brought about by irradiation with 1 MeV electrons. Under this program, several slices of silicon were fabricated for each processing variant. Ten mounted, bonded, and encapsulated devices representative of these slices were then delivered to GSFC for irradiation. The most clear-cut result was the beneficial effect of vacuum baking. The in situ etching also resulted in greater radiation resistance. However, some of the most radiation resistant devices were the result of unknown factors. All devices fabricated were significantly more radiation resistant than commercial MOS transistors. It is recommended that future work be concentrated on structuring the gate and modifying its properties in such a way that more rapid leakage of charge accumulated during radiation is possible. Author

N69-14995*# Philco-Ford Corp., Blue Bell, Pa. Microelectronics Div.
STUDY OF FAILURE MODES OF MULTILEVEL LARGE SCALE INTEGRATED CIRCUITS Interim Report, 15 Apr.–14 Oct. 1967
Earl S. Schlegel Nov. 1967 122 p refs
(Contract NAS12-544)
(NASA-CR-98739) Avail: CFSTI CSCL 09A

Empirical and theoretical studies have improved the understanding of the fundamental electrical properties of the Si–SiO_2 interface of structures having a dielectric layer over the delineated metal layer in multilevel microcircuit structures. A useful model has been developed which provides an over-all view of all the influences on these electrical properties. A number of oxide layers of various materials and deposition processes were evaluated for their possible use as second-layer insulation materials for multilevel LSI circuitry. Vapor-plated SiO_2 and vapor-plated mixed SiO_2–Al_2O_3 were found to be the most promising materials. Feasibility has been demonstrated for a set of test structures, equipment, and techniques for evaluating various insulator materials and deposition processes. An extensive array of data has been compiled on both n-on-p and p-on-n test structures, both with and without a vapor-plated SiO_2 second insulator layer. Author

N69-15002*# Westinghouse Electric Co., Youngwood, Pa. Semiconductor Div.
DESIGN AND DEVELOPMENT OF A HIGH POWER, LOW SATURATION VOLTAGE, MULTI-CHIP SILICON SWITCHING TRANSISTOR Mid-term Progress Report
Ernest R. Stonebraker Dec. 1968 13 p Prepared for JPL
(Contracts NAS7-100; JPL-952309)
(NASA-CR-98716) Avail: CFSTI CSCL 09A

Proposed is a flat-pack encapsulation method for a dual transistor assembly containing silver-Teflon contacts. A compression bond technique is used to mount the transistors with the emitters directly. The obtained narrow profile minimizes electrical and thermal resistance effects as well as lead wire inductance. The method provides hermetic encapsulation for each individual chip, and assembly of matched chips. G.G.

N69-15008# Burndy Corp., Norwalk, Conn. Research Div.
INHIBITION OF CORROSION AND WEAR OF GOLD PLATED CONTACTS
S. J. Krumbein and Morton Antler 26 Jan. 1967 31 p refs Presented at the NEP/CON 1967 West Meeting, Long Beach, Calif., 1 Feb. 1967
(RR-61) Avail: Issuing Activity

The increasing reliability requirements for low voltage electric contacts has led to a search for methods which could make gold plated surfaces impervious to the effects of atmospheric pollutants. The susceptibility of thin gold plate to corrosion is due both to its

inherent porosity and its removal by wear. Because of these breaks in the plate, pollutants can attack the substrate metal or underplate to produce insulating corrosion products. The best methods were the application of a pore blocking inhibitor and a lubricant coating having a liquid component. They inhibited corrosion and wear effectively, without significantly increasing contact resistance compared to untreated samples. These methods were superior to solid lubricant coatings that have been previously proposed. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N69-14024*# Aztec School of Languages, Inc., Acton, Mass.
SELECTION OF AN OPTIMUM MEANS OF REALIZING CONTROL ALGORITHMS FOR AIRCRAFT COMPUTERS [VYBOROPTIMAL'NOGO PUTI REALIZATSII ALGORITHMOV UPRAVLYAYUSHCHIMI MASHINAMI LETATEL'NYKH APPARATOV]
N. T. Berezyuk Washington NASA Dec. 1968 6 p refs Transl. into ENGLISH from the book "Samoletostroyeniye i Tekhnika Vozdushnogo Flota, no. 2" Kharkov, Kharkov State Univ. Press, 1967 p 45–48
(Contract NASw-1692)
(NASA-TT-F-12000) Avail: CFSTI CSCL 09B

A method is developed for determining an algorithm involving the least computational labor in the realization of the transfer functions of automatic control systems on control computers. The method is based on the theory of graphs, and the results are given in the form of theorems. Author

N69-14203*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A TRANSFORMATION TECHNIQUE FOR OPTIMAL CONTROL PROBLEMS WITH A STATE VARIABLE INEQUALITY CONSTRAINT
D. H. Jacobson and M. M. Lele Oct. 1968 27 p refs
(Grant NGR-22-007-068; Contract N00014-67-A-0298-0006)
(NASA-CR-97920; TR-574) Avail: CFSTI CSCL 12A

A slack variable is used to transform an optimal control problem with a scalar control and a scalar inequality constraint on the state variables into an unconstrained problem of higher dimension. It is shown that, for a p-th order constraint, the p-th time derivative of the slack variable becomes the new control variable. The usual Pontryagin Principle or Lagrange multiplier rule gives necessary conditions of optimality. There are no discontinuities in the adjoint variables. A feature of the transformed problem is that any nominal control function produces a feasible trajectory. The optimal trajectory of the transformed problem exhibits singular arcs which correspond, in the original constrained problem, to arcs which lie along the constraint boundary. Generalizations of the approach to cases where the constraint and the control are vectors of equal dimension, as well as to problems involving multiple constraints and a single control variable, are considered. Gradient of conjugate gradient methods are applicable, and computations using the conjugate gradient method are presented. Author

N69-14330*# Colorado Univ., Boulder. Dept. of Electrical Engineering.
COMPUTER-AIDED DESIGN OF SECOND AND THIRD-ORDER SYSTEMS WITH PARAMETER VARIATIONS AND TIME RESPONSE CONSTRAINTS
John W. Smay 14 Oct. 1968 94 p refs
(Grant NGR-06-003-083)
(NASA-CR-96004) Avail: CFSTI CSCL 12A

A systematic design scheme is presented for second and third-order all pole system transfer functions. The system performance specifications are given as inequality constraints on rise time and overshoot of the step response in the time domain. Plant parameters are assumed to vary between known limits. A completed design insures that the time domain constraints are met for all values of the plant. The maximum values of the specifications are assumed at some plant extreme when the structure provides this freedom, resulting in a design which is optimal in the open-loop gain-bandwidth sense. The second-order system is characterized by the usual natural frequency and damping factor. The third-order system is characterized by the coefficients of the denominator polynomial of its transfer function, and these coefficients are related to both the time response and system parameters. The design procedures are reduced to numerical algorithms to permit digital computer solution of the design problem. Author

N69-14337*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A NEW NECESSARY CONDITION OF OPTIMALITY FOR SINGULAR CONTROL PROBLEMS
D. H. Jacobson Nov. 1968 33 p refs
(Grant NGR-22-007-068; Contract N00014-67-A-0298-0006)
(NASA-CR-98597; TR-576) Avail: CFSTI CSCL 12A

A variation in the form of a rectangular pulse of short duration, is introduced into the singular control function. The technique of differential dynamic programming is used to obtain an expression for the change in cost produced by the control variation, and a new necessary condition of optimality is deduced by requiring that this change in cost be non-negative. When terminal equality constraints are present the control variation takes the form of a rectangular pulse followed by a special variation which is chosen to keep the terminal equality constraints satisfied to first-order. Simple control problems are used to illustrate the non-equivalence of the new necessary condition and the generalized Legendre-Clebsch condition. Author

N69-14370 Tulane Univ., New Orleans, La.
A STUDY OF NONINTERACTING CONTROL FOR SAMPLED DATA SYSTEMS
Thomas James Fitzpatrick (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilm: HC $6.20/Microfilm $3.00 Order No. 68-4036

Methods for designing both digital and continuous controllers to decouple multivariable systems are presented. It is further demonstrated that complete elimination of cross coupling effects is always obtained when continuous controllers are employed, but when digital computers are utilized, decoupling is assured only at the sampling instants. To aid in the understanding of the proposed design techniques, numerical examples are included throughout the body of this presentation. Applicability of the proposed method to nonlinear systems is studied via digital simulation of a nonlinear chemical reactor. Overall, the proposed method is shown to be a powerful design tool for the practicing engineer. The transform approaches are straightforward and are quite simple to apply in systems containing a small number of input and output variables. For large multivariable systems, the state variable approach can be easily implemented by a digital computer solution so that tedious algebraic manipulations are eliminated. Dissert. Abstr.

N69-14381 Purdue Univ., Lafayette, Ind.
MINIMUM SENSITIVITY OPTIMAL CONTROL FOR NON-LINEAR SYSTEMS
Abraham Meir Steinberg (Ph.D. Thesis) 1967 72 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-6364

Relaxed Variational Techniques are applied to a minimum sensitivity control problem. Sensitivity of a trajectory is minimized to perturbations in initial conditions. Rather than using the optimal control that does indeed exist and that satisfies the final conditions exactly, a sub-optimal control is used that transfers the system from the given initial state to an arbitrarily small neighborhood of the given final state, and that results in a considerably better performance than the optimal solution. The sub-optimal control is constructed using the optimal controls of the relaxed problem. It is demonstrated by an example that a sub-optimal chattering control obtained for a minimum time problem can be made a function of the states of the system and thus lower sensitivity to perturbations in initial states is achieved as well as minimum time. Dissert. Abstr.

N69-14439*# Colorado Univ., Boulder. Dept. of Electrical Engineering.
DESIGN PROCEDURES FOR DOMINANT TYPE SYSTEMS WITH LARGE PARAMETER VARIATIONS
Don Eugene Olson 12 Nov. 1968 164 p refs
(NGR-06-003-083)
(NASA-CR-96003) Avail: CFSTI CSCL 12A

Design procedures are presented for fourth-order dominant type systems with large plant parameter variations. The s-domain specifications of the system are assumed to be in the form of an acceptable dominant closed loop pole region and bounds on the location of the far-off closed loop poles. The design philosophy is to place compensation zeros within the acceptable dominant closed loop pole region such that the dominant closed loop poles remain within their prescribed region despite the large variations in the plant parameters. Design procedures are presented for variation in the plant gain factory only and for simultaneous variation in the plant gain factor and the plant poles. Finally, an approximate procedure is presented which considers simultaneous variation in the plant gain factor, the plant poles and a plant zero located on the real axis in the s-plane. Author

N69-14488# California Univ., Berkeley. Coll. of Engineering.
DISCRETE SYSTEM THEORY AND BIOCONTROL SYSTEM Final Report, 1 Mar. 1966–31 Mar. 1968
E. I. Jury Mar. 1968 6 p
(Grant AF-AFOSR-292-66)
(AD-677616; AFOSR-68-2310) Avail: CFSTI CSCL 12/1

Problems connected with discrete time systems and usual modeling are discussed in this report. In particular, stability study of pulse frequency modulator feedback systems is tackled in an exact method using Lagrange stability criterion. Also, discussed in this report the problem of system identification and several adaptive algorithms are being presented. In addition to neural modeling, study on the design of neural nets with intermittent response have been accomplished. Other problems connected with stability of nonlinear discrete and continuous feedback systems, multirate sampled-data systems, a general z-transform formula and alternate coefficients constraints for stability test of linear systems are presented. Author (TAB)

N69-14527 Texas A&M Univ., College Station.
ECHELON CONTROL FOR AUTOMATIC CONTROL SYSTEMS
Carl Sanders Droste (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-4990

Echelon control has as its goal the control of a single variable through the interaction of a collection of controllers. Echelon control provides a means of relating a number of controllers or actuators so as to use each at its best advantage in a sort of "chain of command" or "echelon" arrangement. In this configuration each echelon is not aware that higher order echelons exist and each echelon sees only lower order echelons and itself in its feedback loop. In this dissertation the general characteristics of an echelon system are set forth. Significant facets are that the stability of the entire system is dependent on the stability of the individual echelons, the type number of the echelon system is the sum of the type numbers of the individual echelons, and the steady state stiffness to constant disturbances is governed by the highest order echelon. Dissert. Abstr.

N69-14823# Lockheed Missiles and Space Co., Palo Alto, Calif.
SUPPRESSION OF PULSE INTERFERENCE BY USING SUBTRACTING CIRCUITS
Is. I. Gronskii, B. K. Kramarenko, and E. D. Krein [1969] 3 p refs Transl. into ENGLISH from the book "Elem. Sistem Obrabotki Pered. Inform." Kiev, 1965 p 168–171
Avail: Issuing Activity

Details are given on a circuit which is used to extract a signal burst from a background of pulse interference which considerably exceeds the useful signal. It is shown that the subtraction circuit, in combination with a low-Q RC filter, permits qualitative filtration of a signal in the presence of strong interference in the form of radio pulses with steep fronts whose carrier frequency can change within broad limits. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N69-13972# Gulf General Atomic, San Diego, Calif.
NEUTRON ACTIVATION ANALYSIS WITH SMALL ACCELERATORS
Vincent P. Guinn *in* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 1–29 refs (See N69-13971 04-24)
Avail: CFSTI

Small, relatively inexpensive Cockcroft–Walton and Van de Graaff positive-ion accelerators provide useful fluxes of fast neutrons and (with a moderator) thermal neutrons. Neutron fluxes in the range of 10^7–10^{10} n/cm^2-sec can be produced. In this paper attention will be concentrated on the applications in the field of analytical chemistry—via thermal-neutron and fast-neutron activation analysis (NAA). Commercially-available small Cockcroft–Walton deuteron accelerators employ accelerating potentials in the range of 100 to 200 kilovolts, deuteron beam currents of up to 3 milliamperes, and, with a 5-Curie/square inch tritium target, produce up to 3×10^{11} "14 Mev" neutrons per second (isotropic yield), via the 17.6 Mev exoergic $H^3(d,n)He^4$ reaction. Samples of 1–6 cm^3 volume can thus be exposed to 14 Mev neutron fluxes of up to about 10^9 n/cm^2-sec. At such fluxes, some 40 elements can be determined down to levels of 100 μg or less (about 15 down to 1–10 μg). With a moderator, many of these same elements, plus a number of additional elements, can be fairly sensitively determined by means of NAA with thermal neutrons. Author

N69-13982# Texas Nuclear Corp., Austin.
APPLICATIONS: LOW ENERGY ION BEAMS
J. T. Prud'homme *in* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 278–285 refs (See N69-13971 04-24)
Avail: CFSTI

Over the past decade a number of significant applications have emerged that utilize relatively inexpensive low voltage (< 300 kV) ion accelerators. A brief history summarizing application areas

for low energy ion beam and present and future areas of interest will be presented. The basic capabilities of low energy accelerators will be discussed in relation to current research interests. Specific application areas include activation analysis, ion implantation, ionic polishing, low energy nuclear physics research, particle fluorescence and crystallography, and cancer therapy research. Author

N69-14113# Deutsche Forschungsanstalt fur Luft und Raumfahrt, Brunswick (West Germany).
DEVELOPMENT, TESTING AND MEASURING OF A CIRCUIT HOT AIR WIND TUNNEL [ENTWICKLUNG, ERPROBUNG UND VERMESSUNG EINES HEISSLUFTWIND-KANALS]
Wolf Spiettstoesser Jan. 1968 39 p refs In GERMAN; ENGLISH summary
(DLR-MITT-68-14) Avail: CFSTI

The development of an open circuit hot air wind tunnel is reported. It was built for investigating the evaporation of hydrocarbon layers. The determination of the theoretical operating curve of the channel is described. The design of the axial flow blower and the electrically powered heating device as well as the results of the channel testing are presented. The particular requirements to the channel with regard to velocity, temperature, and turbulence are verified in the free jet by means of measurements of the profiles of velocity and temperature as also of the degree of turbulence. Author

N69-14404# Brookhaven National Lab., Upton, N. Y.
DESIGN OF A BUNCHER AND THE TRANSPORT SYSTEM IN ITS DRIFT SPACE FOR THE 200 MeV BNL INJECTOR LINAC
C. Agritellis, R. Chasman et al [1968] 25 p Presented at Conf. on Proton Linear Accelerators, Upton, N. Y. Supported in part by AEC
(BNL-12792; CONF-680515-28) Avail: CFSTI

Numerical buncher calculations taking into account the effects of space charge suggest the following conclusions regarding beam bunching for injection into the new 200 MeV Brookhaven linac. Beams of currents up to 400 mA can be bunched into the longitudinal acceptance of the linac with an efficiency of 50 to 60% by the use of a single buncher whose drift space is 70 to 80 cm. Maximum bunching efficiency can be obtained for a particular current by slight adjustment of the buncher voltage. For 50 mA several double buncher designs were found which can bunch the beam into a phase spread of $\pm 20^{\circ}$ with an efficiency of 60%. It is possible to match the beam transversely at the input of the linac by the use of a quadrupole triplet in the buncher-linac drift space. For a particular buncher design considered in this paper, the required magnetic field gradients in the quadrupoles were found to vary from 0.6 to 1.8 kG/cm for corresponding beam currents between 50 and 400 mA. Author (NSA)

N69-14487# Brookhaven National Lab., Upton, N. Y.
A PRELIMINARY STUDY OF THE TS ZERO MODE AND ITS ROLE IN FIELD FLATTENING OF MULTI AND TUNABLE STEM ACCELERATING STRUCTURES
S. Giordano and J. Hannwacker [1967] 14 p refs Presented at Conf. on Proton Linear Accelerators, Upton, N. Y. Supported in part by AEC
(BNL-12791; CONF-680515-25) Avail: CFSTI

Multistem and alternating tunable atom accelerating structures are studied. A comparison between the dispersion curves for multistem and alternating tunable stems at 30 MeV and 84 MeV is presented. Also, tank stability with a fixed frequency detuning perturbation is studied for both structures. Characteristics of the TS_{100} mode are described, and use of the TS_{100} mode to compensate for perturbations when operating in the TM_{010} mode is discussed. NSA

N69-14507*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ACCEPTANCE TESTING LUNAR AND PLANETARY VEHICLES (A CONCEPT)
Fritz Kramer Washington Dec. 1968 24 p
(NASA-TN-D-4924) Avail: CFSTI CSCL 22D

This report presents the least known of the two concepts which allow us to study the effects of lunar or planetary gravitation on the full-size prototype vehicle with respect to vehicle dynamics and driving characteristics, and to familiarize the astronauts with the behavior of surface vehicles under different gravitations. The concept is explained and illustrated for lunar application because the moon exhibits relative to Earth the smallest gravitational attraction, and causes, therefore, the greatest deviation of the vehicle's behavior from its behavior on Earth. However, the principle and its implementation are applicable without restriction or degradation to any other magnitude of gravitational acceleration. Author

N69-14531# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT, 67, JANUARY-MARCH 1968
Kenneth C. Crebbin and Robert Frias 5 Aug. 1968 14 p
(Contract W-7405-ENG-48)
(UCRL-18259) Avail: CFSTI

The beam was on for 86.9% of the scheduled operating time and the Bevatron accelerated 2.32×10^{18} protons this quarter. One internal-beam experiment was fininshed this quarter and setup of a new experiment in its place was begun. Setup work continued on the new dual-channel external proton beam channel. Preliminary tests were started on the beam channel to the 25-inch bubble chamber. There was a one-week shutdown in February. This is the first of several shutdowns planned in order to effect a reduced level in operation and in experimental physics, as dictated by cutbacks in the high energy physics budget. Work was continued on the resonant extraction system. A new flattop mode of magnet pulsing was tried which is designed to reduce the stresses on the motor generator poles. Author (NSA)

N69-14612# Argonne National Lab., Ill.
RESTRICTION OF THE BEAM CURRENT BY SPACE CHARGE IN THE JINR SYNCHROCYCLOTRON [ORGANICHEMIE TOKA PUCHKA PROSTRANSTVENNYM ZARYADOM V SINKHROTSIKLOTRONE]
V. I. Danilov et al Jun. 1968 29 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res. Rept. JINR-P-2912, 1968
(ANL-TRANS-646) Avail: CFSTI

The size of the beam at the beginning of acceleration for the synchrocyclotron and the Coulomb force components of the beam are calculated. Critical currents are found which are held in the beam by all the focusing forces and can be accelerated at the dee voltage 18 kV. Author (NSA)

N69-14698# Kyoto Univ. (Japan). Aerophysics Lab.
HYPERSONIC GUN TUNNEL
Jul. 1967 26 p refs
(CP-20) Avail: CFSTI

Schematics and summary details are presented on the hypersonic gun tunnel, the gun shock tube (free piston shock tube), and the plasma jet tunnel (arc-heated type low density wind tunnel) installed at Kyoto University. Illustrations are included to show the instrumentation, and performance data are tabulated. The research projects assigned to each test facility are listed. M.G.J.

N69-14811# Weapons Research Establishment, Salisbury (Australia).
EUROPA 1: ACCEPTANCE TESTING OF BREATHING AIR SUPPLIES AT THE LIQUID FUEL AND OXIDANT STORES, E.D.S. Area, Woomera

E. Lowry Aug. 1968 9 p refs
(WRE-TN-DWD-21) Avail: CFSTI

Acceptance testing of air supply systems used for breathing during the storage and handling of propellants is presented. Included are a brief description of the systems, the test method, and the test results. F.O.S.

N69-14818# Hydro- and Aerodynamics Lab., Lyngby (Denmark). Aerodynamics Section.
WIND TUNNEL TESTS IN THE FIELD OF INDUSTRIAL AERODYNAMICS
Henrik Ditlev Jorgensen Mar. 1968 26 p refs
(A-2) Avail: CFSTI

A general description of the HyA wind tunnels and measuring equipment is given. Some testing procedures within the field of industrial aerodynamics are described in detail and general results presented. Applications of low speed wind tunnels within the fields of civil engineering and naval architecture are discussed. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N69-13917 University of Southern Calif., Los Angeles.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF MASS TRANSFER ON A WEDGE INDUCED LAMINAR SEPARATED BOUNDARY LAYER AT MACH 12
Kartheinz Otto Willi Ball (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-5856

An experimental investigation was made to determine the quantitative effect of suction on a hypersonic, separated laminar boundary layer. The test model was a symmetrical fromt wedge of 12° half angle followed by an aft-wedge of flap whose angle could be varied from 0° to 20° with respect to the upper surface of the front wedge in order to form a compression corner. The instrumented surfaces of the model were of thinskin honeycomb construction. Suction was obtained by means of a spanwise slot of variable width between the front and aft-wedge, allowing controlled natural flow from the upper high pressure region of the corner to the relatively low pressure region at the base of the front wedge. The tests were made in the Aerospace Research Laboratories, using a 20 inch hypersonic wind tunnel at a nominal Mach number of 12. Dissert. Abstr.

N69-13945*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
USE OF PHOTOIONIZATION IN MEASURING VELOCITY PROFILE OF FREE-STREAM FLOW IN LANGLEY PILOT MODEL EXPANSION TUBE
Wilfred J. Friesen Washington Dec. 1968 46 p refs
(NASA-TN-D-4936) Avail: CFSTI CSCL 20D

Free-stream velocity profile measurements were made of expansion tube flows for flow core velocities of the order of 6300 m/sec, for flow core densities ρ/ρ_o (where ρ is the gas density and ρ_o is the gas density at standard conditions) from 3×10^{-4} to 2×10^{-3}, and over flow time intervals of about 150 μsec. The method of measurement was based on identifying a region of the flowing test gas by photoionization and, after a delay of a few microseconds, photographing the displaced position of the region by the light emitted when an electrical current was passed through it. The main conclusions reached are that there is a flow core with a radius between 50 and 60 percent of the tube radius, in which the velocity is uniform to within 5 percent, and that the method of measurement is a useful technique for obtaining velocity profiles within the range of test gas density. Author

N69-13993 Iowa State Univ. of Science and Technology, Ames.
NONLINEAR SLOSHING IN ELLIPTICAL TANKS
Kenneth Joseph Kopecky (Ph.D. Thesis) 1967 46 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-2834

This paper considers the irrotational motion of an incompressible, inviscid fluid in a partially filled elliptical tank. The tank is subjected to both transverse and rotational vibrations whose frequencies are near the first natural frequency of small free-surface vibrations. The analysis was performed retaining higher-order terms in the free-surface dynamic and kinematic boundary conditions. The theoretical investigation predicts the forcing frequency ranges, for various combinations of rotational and translational motion, over which there are stable, steady-state, harmonic motions. Dissert. Abstr.

N69-14062#
NUMERICAL SOLUTION OF THE PROBLEM OF VISCOUS SUPERSONIC GAS FLOW AROUND BLUNT BODIES
B. M. Pavlov [1968] 11 p refs Transl. into ENGLISH from the book "Vychislitel'nye Metody If Programmirovanie", no. 11, 1968 p 32-41
Avail: CFSTI

A method of numerical solution is proposed for the problem of viscous gas flow around blunt bodies. The complete Navier-Stokes equations for a compressible gas with adhesion conditions on the body are used. The build-up method is applied. The computation is made according to an explicit difference scheme which possesses second order accuracy in the steady-state solution. A transformation of the independent variables is used which permits carrying out the computation by means of a uniform algorithm in a mesh having the necessary density around the body. Author

N69-14088 New York Univ., N. Y.
UNIFORM ASYMPTOTIC SOLUTIONS FOR POTENTIAL FLOW AROUND A THIN AIRFOIL AND THE ELECTROSTATIC POTENTIAL ABOUT A THIN CONDUCTOR
James Francis Geer (Ph.D. Thesis) 1967 39 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-6063

The two dimensional irrotational flow of an incompressible inviscid fluid past a thin cylindrical airfoil and the two dimensional electrostatic field in the exterior of a thin cylindrical conductor are considered. The complete uniform asymptotic expansions of the two potentials are obtained with respect to ε, the slenderness ratio of the profile curve C of the cylinder. Only curves C which have axes of symmetry are treated. To find the symmetric part of the potential due to the presence of the body, it is represented as a superposition of potentials of point sources distributed along a segment of the axis inside C. The source strength distribution satisfies a linear integral equation. The uniform asymptotic expansion of the solution of this equation is obtained by adapting the method of Handelsman and Keller. The anti-symmetric part is obtained by using the harmonic conjugate of an appropriate symmetric potential. Dissert. Abstr.

N69-14096*# IIT Research Inst., Chicago, Ill.
FLOW IN A TWO-DIMENSIONAL CHANNEL WITH A RECTANGULAR CAVITY
Unmeel B. Mehta and Zalman Lavan Washington NASA Jan. 1969 89 p refs
(Grants NGR-14-004-028; NsG-694)
(NASA-CR-1245) Avail: CFSTI CSCL 20D

The steady state flow characteristics in a rectangular cavity located in the lower wall of a two-dimensional channel whose upper wall was moved with a uniform velocity, were investigated by solving the complete Navier–Stokes equations for laminar imcompressible fluid in terms of the stream function and vorticity. Numerical results were determined for a range of Reynolds numbers from 1 to 500 and for cavity aspect ratios of 0.5, 1.0 and 2.0. A circulating flow extending the whole height was observed for shallow and square cavities. For deep cavity a secondary vortex near the bottom of the cavity was also noticed. Time dependent solutions for the vortex flow in a square cavity bounded by three motionless walls and a fourth moving in its plane were obtained. Author

N69-14104 California Univ., Berkeley.
INVISCID AND VISCOUS MODELS OF THE VORTEX BREAKDOWN PHENOMENON
Hartmut Hans Kurt Bossel (Ph.D. Thesis) 1967 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-5694

In the case of high swirl and large Reynolds number, the Navier-Stokes equations for rotationally symmetric incompressible flow are shown to reduce to 1) a viscous parabolic system for slender (quasicylindrical) flows and 2) an inviscid elliptic system for expanding (or contracting) flows. The inviscid system is solved for the case of flow with initial rigid rotation in a cylindrical stream surface. Assuming different downstream boundary conditions, Fourier-Bessel series solutions are computed for the supercritical (nonoscillatory) case and plotted. The viscous slender problem is formulated in an integral method, using approximating functions for axial velocity and circulation which satisfy boundary and asymptotic requirements. Computational difficulties appear near the suspected breakdown point. Flows resembling breakdown flows are obtained. Dissert. Abstr.

N69-14111*# IIT Research Inst., Chicago, Ill.
PERMEABILITY DATA FOR AEROSPACE APPLICATIONS
Mar. 1968 676 p refs
(Contract NAS7-388)
(NASA-CR-95993) Avail: CFSTI CSCL 20D

A compilation of data is presented on the permeation of propellants and pressurant gases through metals, nonmetals, and composite materials. The form is suitable for use by the designers of spacecraft liquid propulsion systems. The following information is given for each permeant: type or trade name, temperature, permeability rate, permeability rate as reported, units reported, reference, solubility, diffusivity, and relevant comments. C.T.C.

N69-14198# Los Alamos Scientific Lab., N. Mex.
COMPUTER STUDIES OF TIME DEPENDENT TURBULENT FLOWS
C. W. Hirt [1968] 29 p refs Presented at Intern. Symp. on High Speed Computing in Fluid Dyn., Monterey, Calif.
(Contract W-7405-ENG-36)
(LA-DC-9578; CONF-680817-1) Avail: CFSTI

Turbulence can be studied with existing computer technology. One aspect is the study of laminar instabilities, that is, the initial stages in the breakdown of a laminar flow into turbulence, and another is the gross effects of turbulence on a mean flow. Finite difference approximations introduce diffusion-like truncation errors that can obscure the effects of a real viscosity. These errors also influence the computational stability of numerical solutions. A thorough understanding of this point is necessary to avoid confusing numerical instabilities and physical instabilities. The Marker-and-Cell method for computing the dynamics of incompressible fluids with free surfaces is presented. Author (NSA)

N69-14240# California Univ., Berkeley. Aeronautical Sciences Div.
STUDIES OF THE SCATTERING CROSS SECTION FOR THE He–N_2 SYSTEM
Frank G. Collins (Ph.D. Thesis) Sep. 1968 222 p refs
(Grant NSF GK-1297)
(AS-68-9) Avail: Issuing Activity

Total elastic scattering cross sections for the He–N_2 system were measured for relative velocities from 1.68×10^4 cm/sec to 1×10^5 cm/sec utilizing the crossed beam technique. Two collimated, aerodynamically intensified molecular beams intersecting at 10° were used. Each beam had a speed distribution comparable to that obtained from mechanical velocity selectors. The scattering center density was determined from a calibration of the detector utilizing a thermal beam source, carefully considering the geometry of the system. Attenuation of the scattering signal due to the background gas was determined without recourse to pressure-gauge readings. One beam was modulated and integrating techniques were used to recover the signal. The time-of-flight technique was used to determine the initial conditions in each beam. The measurements were compared with quantum mechanical calculations. Generally, the measurements were larger than these calculations. Author

N69-14314*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE STAGNATION-POINT BOUNDARY LAYER WITH SUCTION AND INJECTION IN EQUILIBRIUM DISSOCIATING AIR
Kenneth C. Weston Washington Dec. 1968 89 p refs
(NASA-TN-D-3889) Avail: CFSTI CSCL 20D

Calculations for the compressible, equilibrium dissociating stagnation point boundary layer with suction and injection were performed using a digital computer. Results are shown which reproduce both the perfect gas, linear viscosity-temperature relation calculations of Cohen and Reshotko, and the dissociating air results of Fay and Riddell. Calculations for the dissociated air boundary layer with air injection indicate significantly higher heating rates than those obtained for the perfect gas, linear viscosity-temperature relation model. A procedure is indicated which allows application of the results for air injection to engineering calculations for cases of foreign-gas injection. Author

N69-14316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVISCID FLOW ANALYSIS OF TWO PARALLEL SLOT JETS IMPINGING NORMALLY ON A SURFACE
Richard T. Gedney and Robert Siegel Washington Dec. 1968 32 p refs
(NASA-TN-D-4957) Avail: CFSTI CSCL 20D

Conformal mapping was applied to obtain the flow pattern for two parallel jets of finite width originating from infinity and impinging normally on a plate. The ratio of the half spacing between the jets to the jet width (S/H) is the single parameter governing the flow. Analytical expressions and graphs are given for the free streamlines, internal streamlines, and pressure coefficient along the plate for various values of the S/H ratio. A portion of each jet flows outward along the plate and the remaining flow is a recirculation back toward infinity along the axis between the jets. The amount of recirculation is given as a function of the S/H ratio. Author

N69-14322 Iowa State Univ. of Science and Technology, Ames.
MASSIVE BLOWING IN THE STAGNATION REGION OF A SPHERE USING SECOND-ORDER BOUNDARY LAYER THEORY
Jerome Charles Glaser (Ph.D. Thesis) 1967 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-5952

Solutions are obtained for the stagnation region flow field generated by a re-entry vehicle experiencing large surface mass transfer. The flow field generated by a re-entry vehicle moving at super orbital velocities or that produced when a vehicle encounters the blast from a nuclear warhead of an armed interceptor is of concern in this paper. The objective of this study is to examine the structur of the stagnation region flow field on a sphere generated by very nigh surface blowing rates and to determine the significant parameters that prescribe the geometry of the resulting flow field. The mathematical model for which solutions are obtained in this analysis consists of an outer layer of shock-heated air over an inner layer of gaseous ablation products. The approach presented is to use the method of inner and outer expansions (matched asymptotic expansions) in combination with a series truncation (local similarity) scheme. These are applied to the Navier–Stokes equations to obtain the describing ordinary differential equations to second-order valid near the axis of symmetry. Dissert. Abstr.

N69-14352 Minnesota Univ., Minneapolis.
AN APPLICATION OF THE WIENER–HERMITE EXPANSION METHOD TO THE THEORY OF HOMOGENEOUS TURBULENCE
Dah-teng Jeng (Ph.D. Thesis) 1967 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-7336

The application of the Wiener–Hermite expansion method to the statistical stochastic problems has a number of very attractive features. It expands directly the random variable instead of expanding the distribution function. This work is the first attempt trying to use this expansion method to treat the theory of homogeneous turbulence. We assume that the distribution of the turbulence velocity field is nearly Gaussian so that we can approximate the random velocity by the first two terms of the Wiener–Hermite expansion. The dynamic equations governing the motion are obtained by the Wiener–Hermite expansion of the Navier–Stokes equation. The purpose of this work is to predict the energy spectrum and triple velocity correlation at later stages of decay by the solutions of our dynamic system. The results show reasonable agreement with experiment. Dissert. Abstr.

N69-14362# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLUID AND GAS MECHANICS (SELECTED ARTICLES)
25 Jul. 1967 41 p refs Transl. into ENGLISH from Mekhan. Zhidkosti i Gaza, Akad. Nauk SSSR, no. 5, 1966 p 14–22, 102–104, and 118–120
(AD-677068; FTD-HT-23-594-67) Avail: CFSTI CSCL 20/4

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N69-14363# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXTREMUM NOZZLE CONTOURS FOR GAS FLOWS WITH PARTICLE LAG [EKSTREMAL'NYYE KONTURY SOPEL DLYA POTOKOV GAZA S OTSTAVANIYEM CHASTITS]
L. Ye. Sternin *In its* Fluid and Gas Mechanics 25 Jul. 1967 p 1–18 refs (See N69-14362 04-12)
Avail: CFSTI

An analysis was made of one-dimensional two-phase flow in a Laval nozzle at a small lag of the temperature and velocity of the particles with respect to the gas. The variational problem to determine the maximum impulse of the nozzle was formulated along the contour for a given geometric expension. The impulse losses due to the nonparallelism of the flow were simulated by a function wich depends on the variable ordinate of the contour and the inclination angle of the tangent to the contour. Instead of using the pressure as an argument in the expension series of expressions for the flow parameters as in previous studies, the nozzle ordinate was used. Author

N69-14365# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE CALCULATION OF INTERACTION BETWEEN SUPERSONIC FLOW AND THE LAMINAR LAYER IN THE REGION OF DETACHED FLOW [PRIBLIZHENNYY RASCHET VZAIMODEYSTVIYA SVERKHZVUKOVOGO POTOKA S LAMINARNYM SLOYEM V OBLASTI OTRYVNOGO TECHENIYA]
Ye. N. Bondarev *In its* Fluid and Gas Mechanics 25 Jul. 1967 p 24–31 refs (See N69-14362 04-12)
Avail: CFSTI

This paper presents the distributions of the coefficients of pressure, friction, and heat transfer in the zone of a detached laminar boundary layer ahead of a wedge on a plate. The Cohen and Reshotko integral method was used to calculate the flow in the boundary layer. Author

N69-14366 California Univ., Berkeley.
HEAT AND MASS TRANSFER PROCESSES IN LAMINAR, TWO-PHASE FLOW
Michael Wayne Clark (Ph.D. Thesis) 1967 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-5703

High flux and high concentration level heat and mass transfer experiments have been carried out for several gas-liquid systems which exhibited resistance to transfer in both the liquid and gaseous phases. These experiments were carried out in a horizontal, rectangular duct of high aspect ratio, in which the gaseous and liquid phases were contacted while moving in stratified, laminar cocurrent flow. A calculational method, which utilizes the principle of addition of the individual phase resistances in a trial and error manner, was developed and utilized to predict the interphase high flux, high concentration level mass transfer behavior of the system. In order to ascertain the gas phase resistance for this model accurately, the equation of convective diffusion was solved numerically for the case of a finite interfacial mass flux (high flux) combined with a linear velocity profile away from the mass transfer interface (the Leveque model). Dissert. Abstr.

N69-14424# Argonne National Lab., Ill.
A STUDY OF ONE- AND TWO-COMPONENT, TWO-PHASE CRITICAL FLOWS AT LOW QUALITIES
Robert E. Henry (Ph.D. Thesis) Mar. 1968 77 p refs
(Contract W-31-109-ENG-38)
(ANL-7430) Avail: CFSTI

Two-phase, one-component critical flow was obtained in long tubes for mass flow rates of 512 to 8480 $lb_m/sec\text{-}ft^2$, exit pressures of 40 to 150 psia, and thermodynamic equilibrium qualities of 0.0019 to 0.218. Exit void fractions as well as axial void-fraction profiles were measured by a gamma-ray attenuation technique for void fractions of 0.07 to 0.94. These experimental void fractions resulted in velocity ratios that were considerably less than the existing analytical predictions. Two test sections were designed to investigate the magnitude of two-dimensional effects at the exit plane. Results from these test sections indicate that

previous experimental data are in considerable error for qualities below 10% because of the influence of the downstream two-dimensional expansion on the readings of wall-pressure taps located near the exit plane. A model is developed to predict one-component, two-phase critical flow rates for equilibrium qualities less than 0.02. Author (NSA)

N69-14452#
GAS ESCAPE INTO A VACUUM
G. A. Kuk'ianov et al [1968] 6 p refs Transl. into ENGLISH from Izv. An. SSSR, Mekh. Zhidk. i Gaza, no. 5, 1968 p 146–149
Avail: CFSTI

An approximate scheme to compute the gas parameters in the collisionless domain during escape into a vacuum is proposed for the plane and axisymmetric cases. A surface on which the limiting value of the Mach number is reached is taken as the boundary of the free molecule domain. The gas parameters are determined by assigning the distribution functions on the boundary surface. In principle, the initial distribution is determined by the prehistory of the flow and can be perfectly arbitrary, with the exception of some constraints imposed on the moments of the distribution functions. In the continuum flow zone the distribution function is Maxwellian. Author

N69-14471 Johns Hopkins Univ., Baltimore, Md.
TURBULENT BOUNDARY LAYER CHARACTERISTICS OVER A ROUGH SURFACE IN AN ADVERSE PRESSURE GRADIENT
Victor Everett Scottron (Ph.D. Thesis) 1967 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-6577

The boundary layers produced on rough surfaces in adverse pressure gradients have been investigated. Experimental data on two pressure gradients are studied and compared with flow over a smooth surface. Experimental data obtained with both pitot tubes and hot wires are carefully analyzed and corrected for the effects of high level turbulence. An improved pitot tube correction is proposed. It is shown that a boundary layer on a rough wall will separate more readily than on a smooth wall. Dissert. Abstr.

N69-14483*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR DECAY OF A DISTURBANCE IN AN UNBOUNDED VISCOUS FLUID
Robert G. Deissler Washington Dec. 1968 29 p refs
(NASA-TN-D-4947) Avail: CFSTI CSCL 20D

The nonlinear decay of a disturbance was calculated by an iterative solution to the Navier–Stokes equations. The general expressions obtained for successive approximations were suitable for machine computations, within the limitations of the computer capacity. For the initial condition, a three dimensional cosine distribution with two harmonic terms was assumed. The nonlinear interaction of these harmonic terms then produced new harmonics. As the iteration process proceeded, a large number of harmonics, at wave numbers higher than, lower than, or the same as the original ones were generated. This process appeared to be similar to that occurring in the early stages of the development of turbulence by flow through a grid. Author

N69-14563*# Techtran Corp., Glen Burnie, Md.
FRICTION IN THE PRESEPARATION REGION AND HEAT TRANSFER IN THE SEPARATION REGION ON A TURBULENT BOUNDARY LAYER IN HEATED AIR FLOWING THROUGH DIFFUSERS WITH COOLED WALLS [TRENIYE V PREDOTRYVNOY I TEPLOOBMEN V ZONE OTRYVA TURBULENTNOGO POGRANICHNOGO SLOYA PRI TECHENII NAGRETOGO VOZDUKHA V DIFFUZORAKH S OKHLAZHDAYEMYMI STENKAMI]
P. N. Romenenko et al Washington NASA Dec. 1968 8 p refs
(Contract NASw-1695)
(NASA-TT-F-12022) Avail: CFSTI CSCL 20D

An experimental investigation of friction in the preseparation region and of heat transfer in the separation region of a turbulent boundary layer is discussed for heated air flows in diffusers with cooled walls. An experimental method for determining the point of separation and a behavorial equation for the calculation of heat transfer in the separation region are suggested. Author

N69-14585*# National Aeronautics and Space Administration, Washington, D. C.
TURBULENT BOUNDARY LAYER IN THE PRESENCE OF A PRESSURE GRADIENT DURING INJECTION [TURBULENTNYY POGRANICHNYY SLOY PRI NALICHII GRADIYENTA DAVLENIYA SO VDUVOM]
I. P. Ginzburg et al 1968 11 p refs Transl. into ENGLISH from Gazodinam. i Teploobmen, no. 1 (Leningrad), Izd. Leningr. Univ., Uch. Zap., no. 338, Ser. Mat. Nauk, no. 43, 1968 p 50–59
(NASA-TT-F-12056) Avail: CFSTI CSCL 20D

A calculation is made of the turbulent boundary layer of a gas flow past surfaces with a pressure gradient due to injection. Equations of a semiempirical theory of a two-layer boundary-layer model are used in the process. The procedure is applied to boundary layers formed along plane surfaces positioned at an angle with respect to each other, as in divergent or convergent nozzles, in the absence and presence of injection. Numerical results are given for both types of nozzles with certain specifications. Author

N69-14599*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE SCATTERING OF HIGH ENERGY ARGON ATOMS FROM A WELL CHARACTERIZED (100) TUNGSTEN SURFACE
D. R. O'Keefe Jul. 1968 86 p refs
(Grants NsG-367; DRB G-9551-02; NRC A-2731)
(NASA-CR-98691; UTIAS-132) Avail: CFSTI CSCL 20D

A scattered number flux distributions for nearly monenergetic high energy (0.25 to 2.0 eV) argon atomic beams impinging on the (100) face of a single crystal of tungsten were obtained as part of a basic study of direct comparison with existing and forthcoming theoretical analyses. To permit such comparisons, major emphasis was placed on surface preparation and characterization. The scattering studies were performed in an ultrahigh vacuum environment, with prior surface characterization conducted through the use of optical microscopy and high energy electron diffraction. The amount and kind of adsorbed gas at the surface was inferred during beam bombardment by means of the retarding field diode method which indicates changes in surface work function. A seeded nozzle beam (argon-helium mixtures) was employed to obtain enhanced velocities approaching the satellite velocity range and with very little velocity spread (<10%). Scattered number flux distributions were obtained for an angle of incidence of 45 degrees and for varying surface conditions and beam energies. The peak intensities for all distributions were found to lie below the specular angle and were narrower than the distributions found at the lower energies. Author

N69-14619# Politechnico di Torino (Italy). Istituto di Meccanica Applicata.
RESEARCHES ON RAREFIED GASDYNAMICS, HYPERSONIC FLOW, ROTATING STALL Final Scientific Report, 1 Jan. 1966–31 Jan. 1968
Carlo Ferrari Jul. 1968 10 p refs
(Grant AF-EOAR-28-66)
(AD-677188; AFOSR-68-2192) Avail: CFSTI CSCL 20/4

The researches are concerned with the following subjects: (1) Theoretical study on the interaction between a solid surface and a molecular beam or a free molecular flow. (2) Experimental researches on high temperature gases. (3) Theoretical research on rotating stall in compressor cascades. (4) Theoretical researches on hypersonic flow. (5) Theoretical researches on laminar boundary layer. Author (TAB)

N69-14625# Lockheed Missiles and Space Co., Palo Alto, Calif.
VISCOUS GAS FLOW AROUND A WALL WITH A BREAKPOINT
I. Iv. Brailovskaia [1968] 6 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), no. 13, Iss. 3, 1967 p 41–45
Avail: Issuing Activity

Stationary supersonic viscous compressible gas flow parameters around a wall with a breakpoint are determined. The complete nonstationary system of Navier–Stokes equations for a viscous compressible gas is solved in the neighborhood of the angular point. Nothing is assumed on the orders of magnitude of the desired functions and their gradients. Author

N69-14641# RAND Corp., Santa Monica, Calif.
AN APPLICATION OF THE WIENER-HERMITE EXPANSION TO THE DIFFUSION OF A PASSIVE SCALAR IN A HOMOGENEOUS TURBULENT FLOW
P. G. Saffman Oct. 1968 42 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-677201; RM-5711-ARPA) Avail: CFSTI CSCL 20/4

The report describes the application of a truncated Wiener-Hermite expansion of the velocity and concentration fields to analyze (1) the diffusion and mixing of a passive scalar from a point source in a turbulent fluid, and (2) the spectrum and intensity decay of a homogeneous distribution in an approximately homogeneous flow. The problem has important practical applications in reentry physics and air and water pollution. The truncated Wiener-Hermite expansion is treated as an approximation to the velocity field that must satisfy the Navier-Stokes equations; it is truncated at the first stage that gives nontrivial results. The mean concentration from a point source is shown to satisfy an integro-differential equation with diffusive and wavelike properties. The effective diffusivity is determined in terms of Eulerian velocity coordinates. For the homogeneous case, the concentration spectrum equals the energy spectrum times the mean-square concentration divided by the mean-square velocity component. A modification of Batchelors theory is combined with this equation to predict the decay rate. Author (TAB)

N69-14694# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
THE METHOD OF MOMENTS IN THE SOLUTION OF A FREE MIXING, CHEMICALLY REACTING FLOW FIELD AT CONSTANT PRESSURE
Gdalia Kleinstein Dec. 1968 28 p refs
(RM-434) Avail: Issuing Activity

A theoretical investigation of turbulent free jets has produced a simplified technique which can be used to predict the turbulent portion of the jet flow field. This technique also includes the effect of chemical reactions on the flow assuming that the various chemical species are always in equilibrium. It does not include the effects of shock waves within the jet. This method is readily adapted to different models of the turbulent shear stress. A sample calculation is given for the jet produced by the expansion of hot gases obtained from the combustion of a 200 percent theoretical air-methane mixture. Author

N69-14816# California Univ., Berkeley. Aeronautical Sciences Div.
EXPERIMENTAL INVESTIGATION OF GAS-SURFACE RE-EMISSION DISTRIBUTIONS USING CONTINUUM SOURCE MOLECULAR BEAM TECHNIQUES
Karl Jakus (Ph.D. Thesis) Sep. 1968 177 p refs
(Grant NSF GK-1297)
(AS-68-7) Avail: Issuing Activity

Experimental studies of wall-reemission distributions are described for argon, helium and nitrogen gas beams incident on the 100 planes of single crystal aluminum, silver and lithium fluoride. Lobality in the reflected spatial density distributions was observed for the degassed lithium fluoride target at all temperatures and for the degassed metal targets at elevated temperatures. The variation of the lobality with respect to the incident beam energy, target temperature and angle of incidence followed previously observed trends. Effective reemission temperatures were found to depend on reflection angle and to exhibit certain classes of characteristic behavior including correspondence to target temperature at surface normal and temperature maxima in the vicinity of the density lobe direction. Some structure in the spatial distribution of the effective reemission temperatures from lithium fluoride and silver was also observed. Author

N69-14822# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
THE PART OF THE THERMAL NON-EQUILIBRIUM IN BOILING CO-CURRENT FLOW
H. Wundt Oct. 1968 26 p refs
(EUR-4188-e) Avail: CFSTI

Various hypotheses on the part of thermal non-equilibrium in boiling processes can be found in the literature. In this paper it is attempted not to make assumptions ad hoc (e.g. in order to establish quickly a computer program), but to consider carefully the pertinent elementary mechanisms. This leads to a number of up to now qualitative relationships. Emphasis is laid on the radial temperature and vapor distributions in co-current gas-liquid flow through a heated vertical tube. The structure of these relationships may be helpful in establishing correlations for nucleate boiling heat transfer, because the manner how various parameters (e.g. surface tension and surface roughness) influence the mechanism may better be overlooked. Author

N69-14842# Forsvarets Forskningsanstalt, Stockholm (Sweden).
SIMILARITY SOLUTION FOR AN EXPONENTIALLY EXPANDING SHOCK
N. Hornqvist Sep. 1967 50 p refs
(FOA-4; C-4314-23) Avail: CFSTI

It is shown that a similarity solution exists for an exponentially expanding shock driven by an exponentially expanding piston, assuming that the shock is a strong one, i.e. the backpressure is far greater than the front pressure at the shock. The density of the ambient material is assumed to vary as a power of the distance. One special case including radiation is also treated. The results are given for plane, cylindrical and spherical motion. Author

N69-14850# ARO, Inc., Arnold Air Force Station, Tenn.
WALL COOLING EFFECTS ON AXISYMMETRIC LAMINAR REATTACHING FLOWS AT HYPERSONIC SPEEDS
J. Don Gray Arnold Eng. Develop. Center Nov. 1968 34 p refs
(Contract F40650-69-C-0001)
(AD-677589; AEDC-TR-68-135) Avail: CFSTI CSCL 20/4

A flared (10-deg semiangle) axisymmetric body was tested at Mach 6, 8, and 10 in the von Karman Gas Dynamics Facility to investigate the effect of model wall temperature on the existence of laminar flow separation and reattachment. The results consisted of longitudinal surface pressure distributions obtained at zero incidence. By varying the stagnation pressure, the influence of the

free-stream Reynolds number on the extent of flow separation was also investigated. Extensive measurements were made at Mach 8 for Reynolds numbers (based on centerbody diameter) ranging from about 0.05 to 0.29 million and at wall temperatures from about 0.1 to 0.8 times the free-stream stagnation temperature. Author (TAB)

N69-14874# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
FLOW WITH COUPLED RADIATIVE AND VIBRATIONAL NONEQUILIBRIUM IN A DIATOMIC GAS Interim Report
Scott E. Gilles Sep. 1968 221 p refs
(Contract AF 49(638)-1280)
(AD-677012; SUDAAR-357; AFOSR-68-1895) Avail: CFSTI CSCL 20/4

A theoretical model for the interaction of radiative and vibrational rate processes in the flow of an infrared-active diatomic gas is developed, with specific application to radiative acoustics and to flow through a normal shock wave. Macroscopic equations of radiative transfer and vibrational relation are obtained, that, while retaining the essential features of the microscopic physics, are simple enough to incorporate usefully with the conservation equation of gas dynamics. The transfer equation is linearized about an equilibrium reference state in a plane-parallel geometry. The analysis is then able to retain the essentially nongrey spectral character of the radiative field because the linearization allows the integration over spectral frequency to be carried out independently of the integrations over space. For application in acoustics, the foregoing results are combined with the linearized vibrational rate equation and linearized equations of unsteady, inviscid flow. This leads to a single, sixth-order acoustic equation for a radiating, relaxing gas, which contains the earlier equations for vibrational or radiative nonequilibrium alone as special cases. The consequences of coupling between radiative and molecular nonequilibrium are explored in detail by an analytical, perturbation solution for the flow through a normal shock wave. The relative importance of the radiative process for a given shock strength and upstream temperature increases with decreasing upstream pressure. Author (TAB)

N69-14913# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fuer Angewandte Gasdynamik.
IMPACT PRESSURE MEASUREMENTS IN HYPERVELOCITY, LOW DENSITY ARC HEATED FLOW [PITOTSONDENMESSUNGEN IN HYPERGESCHWINDIGKEITSSTROEMUNGEN GERINGER GASDICHTEN UND HOHER GESAMTENTHALPIEN]
K. Kindler Jan. 1968 40 p refs In GERMAN; ENGLISH summary
(DVL-773; DLR-FB-68-42) Avail: CFSTI

Results of wind tunnel experiments with cooled hemispherical and flat-nosed Pitot impact pressure probes in arc-heated, low-density argon flow are reported. Copper probes of varying geometries were used whose ratios of outer diameter to inlet opening were 19:2 mm, 10:1 mm, and 6:0.8 mm. The data are compared with those obtained in other experimental and theoretical work. A physical explanation is given for the deviations of impact pressure measurements from the inviscid values in flows of rarefied gases. K.W.

N69-14915 Utah Univ., Salt Lake City.
A STUDY OF THE VISCOUS SUBLAYER IN TURBULENT FLOW
Ronald Lee Meek (Ph.D. Thesis) 1968 278 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 68-6549

The formulation of the Einstein-Li description required the introduction of an arbitrary velocity at the boundary between the growing sublayer and the turbulent core and the postulate that the turbulent field penetrates completely to the bounding surface as the sublayer collapses. In the present formulation, this boundary velocity was evaluated in a straightforward manner by means of continuity requirements; and consideration was given to the effects anticipated if the decay process stops short of the wall. Also, the transport of momentum in the turbulent core was assumed to be describable by means of mixing-length theory; and, since a stability-transition criterion for the growing sublayer is not available, it was necessary to use the Prandtl form of the friction-factor Reynolds-number relationship to complete the formulation. Dissert. Abstr.

N69-14964*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
POSSIBLE APPROXIMATE METHODS OF SOLVING THE PROBLEMS OF A TURBULENT BOUNDARY LAYER DURING THE MOTION OF A GAS MIXTURE [VOZOMOZHNYYE PRIBLIZHENNYYE METODY RESHENIYA ZADACH TURBULENTNOGO POGRANICHNOGO SLOYE PRI DVIZHENII SMESI GAZOV]
I. P. Ginzburg Washington NASA Dec. 1968 18 p refs Transl. into ENGLISH from Gozodinam. i Teploobmen, no. 1 (Leningrad), Leningr. Gos. Univ., Uch. Zap., no. 338, Ser. Mat. Nauk, no. 43, 1968 p 36–50
(Contract NASw-1692)
(NASA-TT-F-12055) Avail: CFSTI CSCL 20D

A general statement is made of the problem of the motion of a gas mixture in a turbulent boundary layer. Equations of motion and other basic relations are given for a semiempirical theory of turbulence. Approximate solutions for this problem are developed. Friction, heat content, and gas-component concentration, given in polynomial form, are used as the basis of these solutions. The relation between the heat content and the gas-mixture flow velocity in a boundary layer is analyzed. An approximate method of determining the friction coefficient is developed as a result. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N69-13913*# RAND Corp., Santa Monica, Calif.
RELATION OF THE WESTWARD DRIFT OF THE GEOMAGNETIC FIELD TO THE ROTATION OF THE EARTH'S CORE
A. D. Richmond Dec. 1968 24 p refs
(Contract NASr-21(05))
(NASA-CR-98603; RM-5861) Avail: CFSTI CSCL 08N

The concept of equating the drift of the geomagnetic field with a similar drifting motion of the earth's core is examined. The drift of the field at the earth's surface and at the core is calculated, and the two values are shown to be considerably different. Analysis of the portion of secular change remaining after westward drift effects have been removed is used to provide an estimate of the error in the drift which results from equating the drift of the field to that of the core. On this basis the best estimate of the westward drift of the core for epoch 1960 is found to be 0.13 degrees per year, with an estimated error of $\pm 0.03^{\circ}$/yr. This drift is considerably smaller than the values usually cited for the core's rotation, such as 0.18 degrees per year obtained by Bullard and others, based mainly on charted differences in surface data. Author

N69-13916 California Univ., Los Angeles.
THE PROBLEM OF HYDROGEN ESCAPE IN THE EARTH'S UPPER ATMOSPHERE, A REAPPRAISAL
Stephen Keung Lew (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-7473

Two different models of the region of the Earth's upper atmosphere near the critical level are constructed, one model assuming a homogeneous atmosphere, and the other an atmosphere in diffusive equilibroum in a gravitational field. By means of the Monte Carlo method, the behavior of individual atoms of the hydrogen gas in this region as they interact with oxygen atoms of the background gas is simulated; their transport from the bottom of the region where they are initially introduced up into the higher levels is studied statistically. Dissert. Abstr.

N69-13927*# Geological Survey, Denver, Colo.
STRUCTURAL GEOLOGIC INTERPRETATION FROM RADAR IMAGERY
R. G. Reeves Dec. 1968 28 p refs
(NASA Order R-09-020-011)
(NASA-CR-98594; NASA-102) Avail: CFSTI CSCL 08F

Certain structural geologic features may be more readily recognized on sidelooking airborne radar (SLAR) imagery than on conventional aerial photography or other remote sensor imagery or by ground observations. SLAR systems look obliquely to one or both sides. SLAR images resemble aerial photographs taken at low sun angle, with the sun directly behind the camera, but differ from them in geometry, resolution, and information content. Radar operates at much lower frequencies than the human eye and camera or infrared sensors, and thus sees differently. The lower frequency enables it to penetrate most clouds and some precipitation, haze and dust, and some vegetation. Radar provides its own illumination which can be closely controlled in intensity and frequency. It is narrow band, or essentially monochromatic. Lineaments interpreted as faults stand out and folded sedimetary rocks cut by faults can be clearly seen on radar imagery. Certain structural and stratigraphic features are more pronounced on the radar imagery than on conventional photography, and the radar imagery materially aids structural interpretation. Author

N69-13950 Wisconsin Univ., Madison.
ENERGY EQUATIONS AND THEIR APPLICATION TO A LIMITED REGION OF THE ATMOSPHERE
Phillip Joseph Smith (Ph.D. Thesis) 1967 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 67-17027

Energy budget equations applicable to any limited atmospheric region are developed employing the concept of available potential energy and used to calculate the energy budget over North America for March, 1962. These equations contain, in addition to the customary generation, conversion, and dissipation terms, expressions for the boundary fluxes. Since it appears necessary to use a global reference state, the local available potential energy (A) is defined as the contribution the limited region makes to the global available potential energy. In this study this leads to mean values of A that are negative. The energy budget estimates obtained here differ in a number of ways from the global, annual budget values. The generation value obtained here is quite small, probably reflecting the reduced zonal heating effects in this region. The boundary fluxes and pressure work estimates, both of which are zero in the global budget, demonstrate the significant interaction between the limited region and its environment. Dissert. Abstr.

N69-13953 Wisconsin Univ., Madison.
A RADIATION MODEL IN WHICH THE EFFECTS OF CLOUDS ARE SIMULATED FROM MOISTURE AND TEMPERATURE PARAMETERS
Stephen Kent Cox (Ph.D. Thesis) 1967 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-16917

This thesis describes a means to include the effects of clouds on solar and longwave radiation transfer in a primitive equation numerical general circulation model where moisture is carried as a dependent variable. Specific information on cloudiness is not required even though the radiation results include the likely effects of clouds. Vertical profiles of moisture and temperature are used as input data, and the radiative effects of clouds are inferred from the profiles. The infrared technique was developed from a large number of radiation sonde observations representing various locations, seasons and sky conditions. The infrared computation was made for two sets of independent observations of pressure, temperature and moisture, for which coincident radiation measurements were available. A comparison between observed and calculated radiative cooling rates showed that the technique can reproduce synopticscale radiative cooling patterns. Dissert. Abstr.

N69-13990# National Environmental Satellite Center, Washington, D. C.
MONTHLY AND SEASONAL MEAN GLOBAL CHARTS OF BRIGHTNESS FROM ESSA 3 AND ESSA 5 DIGITIZED PICTURES Technical Report, Feb. 1967–Feb. 1968
V. Ray Taylor and Jay S. Winston Nov. 1968 50 p refs
(ESSA-TR-NESC-46) Avail: CFSTI

Global charts of mean brightness from ESSA 3 and 5 digitized pictures are presented for the four seasons, March 1967 through February 1968, and for 13 months, February 1967 through February 1968. The various steps taken to prepare these charts are discussed, and the chart format is explained. Author

N69-14005 Wisconsin Univ., Madison.
AN INVESTIGATION OF ATMOSPHERIC STRUCTURE IN THE LOWER TROPOSPHERE BY LIDAR PROBING
John Albert Reagan (Ph.D. Thesis) 1968 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-5348

Model tropospheres and model lidar returns are presented to introduce a method for inferring the response of lidar to atmospheric structure. It is proposed that lidar can indirectly detect structural features by using the distribution of atmospheric particulate as a tracer. Vertical distributions of atmospheric temperature and humidity are modeled for different meteorological conditions, and the particulate distributions and corresponding lidar responses are qualitatively developed for each case. Different methods for extracting information from lidar returns are examined. Analytical compensation methods and experimental comparative techniques are proposed. Unique simultaneous lidar-meteorological observations are presented and compared. Results are given which display the sensitivity of lidar to structure associated with variations in the vertical distribution of atmospheric temperature and/or humidity. It is shown that the proposed model lidar returns favorably agree with experimental observations when meteorological conditions approximated the model tropospheres. Dissert. Abstr.

N69-14102*# Aztec School of Languages, Inc., Acton, Mass.
SOME PROBLEMS ASSOCIATED WITH THE TEMPERATURE SOUNDING OF THE ATMOSPHERE [NEKOTORYYE VOPROSY TERMICHESKOGO ZONDIROVANIYA ATMOSFERY]
K. Ya. Kondrat'yev and Yu. M. Timofeyev Washington NASA Dec. 1968 18 p refs Transl. into ENGLISH from Probl. Fiz. Atm. (Leningrad), no. 5, 1967 p 89–94
(Contract NASw-1692)
(NASA-TT-F-11988) Avail: CFSTI CSCL 04A

The methods used in the temperature sounding of the atmosphere and the problems associated with these methods are

reviewed. Particular attention is given to the determination of the influence of the variability of CO_2 and water vapor concentration, and the temperature dependence of the transmission function on the outgoing radiation. Author

N69-14105 Pennsylvania State Univ., University Park.
POLYMORPHISM OF TiO_2 MINERALS
Philip Yale Simons (Ph.D. Thesis) 1967 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3561

The polymorphism of the TiO_2 minerals anatase, brookite, and rutile was studied from room temperature and pressure to a pressure of 100 kbars and a temperature of 800C. Experiments were conducted in shear and non-shear opposed anvil devices and Tuttle cold seal pressure vessels. It was found that both anatase and brookite undergo a high pressure phase transition to a new phase called TiO_2 II. Others have shown rutile also can transform to this phase under pressure. The anatase to TiO_2 II reaction occurs in the presence of a short range order (SRO) phase, but with the x-ray method used no such phase was detected with the TiO_2 II prepared from brookite. Dissert. Abstr.

N69-14112# Hawaii Inst. of Geophysics, Honolulu.
PERFORMANCE OF THE SEISMIC SEA WAVE WARNING SYSTEM, 1948–1967
Doak C. Cox Mar. 1968 86 p refs
(HIG-68-2) Avail: CFSTI

An historical account is presented on the Seismic Sea Wave Warning System (SSWWS), established in August 1948 principally to serve the Hawaiian Islands. Now renamed the Tsunami Warning System (TWS), it has undertaken international service. Its objective is cited as the minimization of the hazards of tsunamis, especially hazards to human life and health, through the issuance of warnings for public dissemination by cooperating agencies. The warnings are based on seismic evaluation and, especially, on mareographic confirmation of tsunami generation. Improvements have been made in seismographic and mareographic instrumentation, coverage, and analytic techniques since the SSWWS was established, and additional improvements are recommended. The most promising improvement is a just-developed capability for mid-ocean maerography. Decision-making policies also have been improved, but further improvement and clarification is recommended. In particular, implementation of a policy of regional evaluation of tsunami hazard is required. Author

N69-14132# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE RELATIONSHIP BETWEEN MAGNETIC STORMS AND ATMOSPHERIC CIRCULATION
B. A. Yakovlev 7 Dec. 1967 11 p Transl. into ENGLISH from Tr. Pervoy Nauchn. Konf. Obshch. Tsirkulyatsii Atmosfery (Moscow) 1962 p 142–148
(AD-677134; FTD-HT-23-1473-67) Avail: CFSTI CSCL 4/1

Investigation of data on strong and very strong magnetic storms of at least two days duration, recorded by the Murmansk Division of the Institute of Terrestrial Magnestism, Ionosphere, and Radio Wave Propagation of the Academy of Sciences of the USSR during the period 1 January 1955 to 31 July 1959, has shown that there is a tendency of magnetic storms to recur at approximately equal periods of time. The most frequently observed periods were: 14 plus or minus 1, 26 plus or minus 1, 29 plus or minus 1 and 56 plus or minus 1 days. Cyclogenesis developed more actively from the second day after the commencement of the magnetic storm to the second day after its termination, and the development of low cyclones into high-level cyclones was accelerated. At the time of magnetic storms during the cold season, there is a tendency for cyclonic activity to intensify from Iceland toward the Barents Sea. In the warm season, during magnetic storms, there is a tendency for the temperature to rise in this same region. The article includes an analysis of processes during two magnetic storms. Author (TAB)

N69-14172# Innsbruck Univ. (Austria).
MEASUREMENT OF THE CONDUCTIVITY AND DIELECTRIC CONSTANT OF A HOMOGENEOUS MEDIUM BY MEANS OF WAVE PROPAGATION
Robert Nessler Jul. 1968 24 p refs
(Contract AF 61(052)-902)
(AD-677587; AFCRL-68-0440; SR-7) Avail: CFSTI CSCL 8/7

A method is described which permits the determination of the electric rock parameters epsilon and sigma by integrating over a certain region by means of wave propagation. The evaluation is made graphically by means of families of curves. Accuracy determination of the resulting values is possible by means of error tables. Author (TAB)

N69-14231# Bureau of Mines, Denver Colo. Mining Research Center.
INFLUENCE OF SPHERICAL HEAD SIZE AND SPECIMEN DIAMETERS ON THE UNIAXIAL COMPRESSIVE STRENGTH OF ROCKS
John R. Hoskins and Frank G. Horino Jan. 1969 20 p refs
(BM-RI-7234) Avail: Issuing Activity CSCL 08

Uniaxial compressive strength of rock is usually determined in the laboratory from cylindrical samples that vary in diameter from 5/8 to 8 inches, using a spherically seated compression head of unspecified size. The Bureau of Mines conducted a series of tests on limestone, marble, sandstone, granite, and plaster of paris to determine the influence of the spherical head sizes and the specimen diameters themselves on the uniaxial compressive strength. Cylindrical samples of several different diameters of each rock type, all having a length of twice their diameter, were prepared and broken using at least three different diameter spherical heads. Analysis of the data shows that spherical head size does not significantly affect the uniaxial compressive strength of cylindrical rock samples. However, the diameter of the rock specimens does significantly affect the uniaxial compressive strength. Within the range of specimen diameters tested, a coefficient of variation of 6.4 percent for plaster of paris can be attributed to the selection of specimen diameter alone. Similarly, a maximum coefficient of variation of 4.7 percent for the rock types tested can be attributed to the specimen diameter alone. Author

N69-14235# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
MARKING OF GEODETIC POINTS IN OPEN MOUNTAIN REGIONS [MARKIROVKA GEODEZICHESKIKH TOCHEK V OTKRYTYKH GORNYKH RAYONAKH]
M. S. Kryuger Aug. 1968 11 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 11, 1965 p 47–51
(AD-677182; ACIC-TC-1450) Avail: CFSTI CSCL 8/5

The mountain-plateau desert begins at an elevation of from 1100-1500 meters in the mountain regions of Yakutia. It is almost completely barren of overgrowth. Artificial materials must be used for marking reference points in plateau regions in order to have reliable identification. In the particular operation discussed, gauze and white calico were used. The calico was more expensive and heavier than the gauze. The practice of marking reference points with foil glued to thick paper was tested. The shiny surface as a signal has much merit, but because of weather conditions, great care must be taken to properly prepare the foil markers. Author (TAB)

N69-14251*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
INVESTIGATION OF CONTINENTAL DRIFT, PHASE 1 EFFORT Progress Report, 1 Apr.–30 Sep. 1968
Carlton G. Lehr, Ursula B. Marvin, and Paul A. Mohr Nov. 1968 93 p refs
(Contract NSR-09-015-079)
(NASA-CR-98653; SAO-811-143) Avail: CFSTI CSCL 08E

The feasibility is examined of applying two high precision distance measurement techniques to test for the existence of continental drift: ultrashort-pulse laser ranging, and independent-clock radio interferometry. Criteria for determining likely geophysical areas for such measurements are investigated, and an overview is presented on the related phenomena of continental drift, sea floor spreading, and global tectonics. Also discussed is the theory of gross crustal motion which subdivides the earth's surface into six major blocks, each undergoing slow rotational motion relative to the others. The theory of the interferometer is considered in relation to accurate positional determinations, and the steps involved in data reduction are outlined. The status of laser systems and the prospects for improving them are reviewed. Proposed techniques for lessening uncertainties in interferometer and laser measurements are assessed. It is concluded that any realistic measurement program must include a variety of coordinated techniques and a combination of observational approaches, with artificial satellites playing a leading role. A simulation tool for modeling the candidate systems is described. M.G.J.

N69-14260*# RAND Corp., Santa Monica, Calif.
ON THE DETERMINATION OF SURFACE MOTIONS OF THE EARTH'S CORE
R. H. Ball, Anne B. Kahle, and E. H. Vestine Dec. 1968 52 p refs
(Contract NASr-21)
(NASA-CR-98601; RM-5615-NASA) Avail: CFSTI CSCL 08N

The general problem of inferring fluid velocities in the core from magnetic data is discussed and previous results are compared with one another. Earlier analysis is extended by allowing for small contributions to secular change from magnetic diffusion, while constraining the velocity to satisfy a quasi-geostrophic condition. The latter dynamic condition is derived from first principles, and allows for electromagnetic forces in addition to the Coriolis force. The under-determined system of equations is solved by applying a variational principle which requires nonsingular solutions corresponding to a given magnetic Reynolds number. Solutions are shown for several values of the Reynolds number. These include estimates of surface electrical-current patterns. Author

N69-14267# Environmental Science Services Administration, Boulder, Colo. Atmospheric and Physics Chemistry Lab.
OZONESONDE INTERCOMPARISON TESTS Final Report, Jun. 1968
W. D. Komhyr, R. D. Grass, and R. A. Proulx Sep. 1968 79 p refs
(BuWeps Order 19-64-8050-Weps)
(ERL-85-APCL-4) Avail: SOD

Dual instrument releases, employing combinations of Regener chemiluminescent, Brewer–Mast electrochemical, and carbon–iodine electrochemical ozonesondes, were made to compare the performance of the sondes. Although attractive because of their specificity to ozone and rapid response time, the Regener instruments exhibited degradation of data due to unstable chemiluminescent disc characteristics. Paired Brewer–Mast instrument flights revealed the sondes' excellent tracking capability, i.e., the ability of different instruments to provide closely similar data; measured ozone values, however, were low in all instances. The carbon–iodine sondes showed less favorable tracking ability and a slightly slower response than did the Brewer–Mast sondes, but ozone values were generally well indicated on an absolute scale. The field test, as well as supplemental laboratory tests, indicated a need for improvements in the three types of instruments. Author

N69-14290*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
A PRELIMINARY STUDY OF THE DETECTION OF GEOMORPHOLOGICAL FEATURES OVER NORTHEAST AFRICA BY SATELLITE RADIATION MEASUREMENTS IN THE VISIBLE AND INFRARED
Jean Pouquet and Ehrhard Raschke Washington Dec. 1968 20 p refs
(NASA-TN-D-4648) Avail: CFSTI CSCL 08F

Measurements from the meteorological satellite Nimbus 2 of reflected solar and emitted infrared radiations, day and night, over Northeast Africa were used to investigate some geomorphological features of the ground. It was found: (1) The daytime measurements of emitted longwave radiations are deceptive because of the differences in local solar times across a scan. (2) Nighttime measurements are closely related to solar reflectances over the same areas. (3) When nighttime infrared measurements depart from the general trend shown by the reflectance, this opposition helps in the detection of such geomorphological features as rock formation and soil moisture. It is pointed out that these investigations are no more than a tentative approach restricted chiefly because of the low resolution of the medium resolution infrared channels of Nimbus 2. Author

N69-14318# Illinois Univ., Urbana. Electrical Engineering Research Lab.
AN INVESTIGATION OF F2 REGION IONOSPHERIC BEHAVIOR BY COMPUTER METHODS
James H. Fritz and K. C. Yeh Aug. 1968 91 p refs
(Contract F19628-67-C-0028)
(AD-676993; AFCRL-68-0419; TR-35; SR-1) Avail: CFSTI CSCL 4/1

This is an investigation of the solution of the continuity equation modeled for the F2 region of the ionosphere. Since a numerical method is used to obtain the solution on a digital computer, variations of the model and their effects on the solution for electron densities are all investigated. Several current suggestions for explanations of some of the ionospheric anomalies are studied in this manner. Author (TAB)

N69-14336*# Allied Research Associates, Inc., Concord, Mass.
ACCURATE CLOUD COVER DETERMINATION AND ITS EFFECTS ON ALBEDO COMPUTATIONS Final Report
James C. Barnes and David Chang Oct. 1968 91 p refs
(Contract NAS5-10478)
(NASA-CR-98596; REPT-9G53-12) Avail: CFSTI CSCL 04A

The effect of accurate cloud cover determination on computation of the earth's albedo is investigated through utilization of Nimbus II photographic and radiometric data. Satellite observed cloud cover, extracted primarily from Automatic Picture Transmission photography, is compared with standard surface observations for selected locations in the eastern United States. To determine whether cloud observations from viewed areas of limited size are applicable to albedo computation, a detailed analysis of cloud reflectance, obtained from MRIR (Medium Resolution Infrared) observations, is carried out for areas of uniform cloud cover. Based on the technique used in this study for the identification of various clouds viewed by the satellite, it appears that unique cloud type signatures can be deduced from the MRIR data. The possible application of these signatures to objective cloud type analysis is discussed. Author

N69-14361 Missouri Univ., Columbia.
SKY COVER INFLUENCE ON TOTAL HEMISPHERIC RADIATION
Larry Otto Pochop (Ph.D. Thesis) 1967 167 p
Avail: Univ. Microfilm: HC $7.80/Microfilm $3.00 Order No. 68-3643

Continuous measurements of incoming total and solar radiation were made, for a period of one year, with instruments mounted on

the roof of the Weather Bureau Building located at the Columbia Municipal Airport, Columbia, Missouri. The radiation detectors were a Beckman and Whitley total hemispheric radiometer and an Eppley pyrheliometer. Incoming long-wave radiation values were calculated as the difference between total and solar radiation. Sky cover was measured by photoelectric scanning of whole-sky negatives, with exposures of the sky made hourly during the daylight hours. Regressions were calculated relating daylight and average hourly values of incoming radiation to sky cover. The ratios of total, solar, and long-wave radiation to the radiation received at the top of the atmosphere and to the emitted flux density of the earth's surface as affected by sky cover variations were also investigated.
Dissert. Abstr.

N69-14379# Naval Research Lab., Washington, D. C.
SCINTILLATION RANGE NOISE AND RELATED PHENOMENA IN WATER WAVE PROFILING WITH MICROWAVE RADAR Interim Report
Arno M. King, Christopher M. Morrow, Chauncey G. Myers, and Calvin L. Moody Sep. 1968 180 p refs
(AD-677030; NRL-6641) Avail: CFSTI CSCL 8/3

Wave-profile recording by radar from a low-flying conventional aircraft offers a means of rapidly collecting large amounts of oceanographic data over wide areas of the ocean in a relatively short time. A series of radar experiments has been conducted from a laboratory suspended beneath the Chesapeake Bay Bridge. The purpose of the series of experiments was to study the problems of wave-profile recording and to make comparisons with standard radar altimetry. Theoretical and experimental analyses based on the work conducted at the bridge laboratory indicate that target-scintillation noise limits the accuracy of a microwave radar used for wave profiling. However, it has been concluded that a properly designed airborne FM-CW radar can produce ocean-wave recordings of sufficient accuracy for all ordinary oceanographic purposes. The specifications for such a system have been developed. One of the basic requirements has been found to be a broad transmitted spectrum, probably in excess of 100 Mc/sec; this requirement appears to be independent of the exact form which the radar system takes.
Author (TAB)

N69-14450*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN APPROACH TO THE REMOTE DETECTION OF EARTH RESOURCES IN SUB-ARID LANDS
Jean Pouquet Washington Dec. 1968 26 p refs
(NASA-TN-D-4647) Avail: CFSTI CSCL 08I

The purpose was to find a better geological tool utilizing the nighttime infrared radiations emitted by the ground, and thereby obtain a better knowledge of the agricultural possibilities of arid and sub-arid lands. The equivalent black body temperatures derived from Nimbus 2 high resolution infrared radiometer in the spectral range 3.5–4.2μ (atmospheric window) were analyzed for all available orbits from May until mid-November 1966. From this preliminary study certain predominant features emerged and were used as a basis for the interpretation of data. For the final interpretation only a few examples were selected: Death Valley and surroundings, and Salton Sea–Colorado River region. The principal results are: detection of tectonic accidents, already known, with emphasis upon the western branch of the San Andreas Fault system; reconstitution of the upper Pleistocene hydrographic patterns showing the link between Saline, Panamint, and Death Valleys, and the Colorado River, and the former courses of this river; the possibilities of humidity storage suggested by areas showing slightly higher nighttime temperatures than expected; close relationships between the agricultural possibilities involved in the preceding statement and the geomorphological stage reached by the different valleys and basins.
Author

N69-14463# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF THE RESONANCE PERTURBATION OF THE IONOSPHERE ON THE SURFACE OF AN ANTENNA MOUNTED ON AN ARTIFICIAL EARTH SATELLITE
A. V. Gurevich et al 16 Nov. 1967 15 p refs Transl. into ENGLISH from the Proceedings of the Fifteenth Intern. Astronautical Congr., Warsaw, Poland, 7–12 Sep. 1964
(AD-677691; FTD-HT-1278-67) Avail: CFSTI CSCL 4/1

The author describes a method to study the ionosphere by measuring the constant component of the electric current flowing from the ionospheric plasma to an electrode to which a high-frequency electric potential has been applied.
TAB

N69-14495 Michigan Univ., Ann Arbor.
THE TRANSIENT PART OF THE ATMOSPHERIC PLANETARY WAVES
James Henry Stobart Bradley (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17732

The transient parts of the atmospheric planetary waves are studied observationally, using characteristic patterns and simple time filters to separate free, forced and standing modes. The fast moving parts of the planetary waves have phase angles and velocities which are independent of meridional wave-number but a function of zonal and vertical wavenumber, except when a subdominant meridional characteristic pattern is excited. The phase speeds have approximately the Rossby-Haurwitz values corresponding to the dominant meridional characteristic pattern. The observed modes are strongly coupled by the vertical and meridional shear of the horizontal wind, and energy is exchanged at typical periods short compared to the typical periods of fluctuations in phase velocity. Limits of random, contingent and systematic error of the objective analysis system are estimated, and the feasibility suggested of extracting greater value from existing data.
Dissert. Abstr.

N69-14509# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
ANALYTICAL PROCEDURES USED BY THE GEOCHEMISTRY SECTION FOR URANIUM, RADON, AND RADIUM [METHODES D'ANNALYSES UTILISEES PAR LA SECTION DE GEOCHIMIE URANIUM, RADON, RADIUM]
Pierre Berthollet Jun. 1968 54 p refs In FRENCH
(CEA-R-3557) Avail: Issuing Activity

The analytical methods described are applied to the geochemical prospecting of uranium. The nature of the material under investigation, which may be soil, alluvium, rock, plant or water, and the particular requirements of geochemical exploration, prompted an adjustment of the widely used conventional methods to the demands of large scale operation, without lowering their standards of accuracy and reliability. These procedures are explained in great detail.
Author (NSA)

N69-14540# Pittsburgh Univ., Pa. Dept. of Chemistry.
RESEARCH DIRECTED TOWARD THE STUDY OF CHEMICAL REACTIONS OF EXCITED ATMOSPHERIC SPECIES Final Report, 1 Mar. 1965–29 Feb. 1968
Frederick Kaufman Jun. 1968 37 p refs
(Contract AF 19(628)-5056)
(AD-677000; AFCRL-68-0466) Avail: CFSTI CSCL 4/1

Two series of experiments are described. In series A, line absorption measurements on the resonance line triplets of O and N were analyzed and the oscillator strengths of these transitions are determined. Sigma-gf is found to be 0.19 plus or minus 0.03 for O, and 0.87 plus or minus 0.19 for N. Information is also obtained on the deactivation of metastable N(2)D by Ar, N2, or O2. In

series B, the fluorescence of NO2 was studied by monochromatic excitation at 4360, 5460, and 5780A, and monochromatic measurement of fluorescence from the incident wavelength to 7850A. Lifetimes are also measured using the phase shift method and modulated exciting light. Strong evidence is presented for the efficient vibrational relaxation of the excited state. The radiative lifetime of $NO2^{\bullet}$ is found to be 55 plus or minus 6 microsec, and negative evidence is presented for the contribution of another excited state of shorter lifetime. Author (TAB)

N69-14558# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
COLLECTION AND ESTABLISHMENT OF GEOGRAPHIC NAMES IN UNINHABITED REGIONS [SBOR I USTANOVLENIE GEOGRAFICHESKIKH NAZVANII V NEOBZHITYKH RAYONAKH]
V. N. Lebedev Oct. 1968 9 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 8, 1966 p 47–49
(AD-677184; ACIC-TC-1463) Avail: CFSTI CSCL 8/5

The translation deals with the problem of establishing one geographic name for a particular point in a region. Author (TAB)

N69-14626# California Univ., La Jolla. Dept. of Physics.
REVIEW SUMMARY OF SESSION 5—THEORY
W. I. Axford Jun. 1968 4 p
Avail: Issuing Activity

As substantial agreement is reported about the processes which lead to the production of temperature zone sporadic E, the discussion centered on refinements of the wind-shear theory and on the special problems associated with the production and loss of metallic ions. These pertain to (1) the rate of loss of metallic ions into the D-region due to the corkscrew mechanism, and the difficulties that arise unless the sweeping effect in inhibited by the presence of standing waves; (2) a model of the corkscrew mechanism which shows that E_s layers formed of long-lived ions follow nodes in the effective neutral wind profile down to altitudes less than 100 km; (3) numerical solutions for the formation (by the wind shear mechanism) of E_b layers comprised of molecular ions; (4) the effects of gravity waves; and (5) the formation of irregularities of ionization density by the crossed-field instability. M.G.J.

N69-14640# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
GEODETIC METHOD FOR DETERMINING REFRACTION CORRECTIONS IN THE AZIMUTH AT LAPLACE STATIONS [GEODEZICHNYI METHOD VYZNACHENNYA POPRAVOK ZA REFRAKTSIYU V AZIMUTI NA PUNKTAKH LAPLASA]
A. L. Ostrovskyi Oct. 1968 12 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), ser B, no. 3, 1967 p 226–229
(AD-677211; ACIC-TC-1442) Avail: CFSTI CSCL 8/5

The translation is a discussion of the problem of reducing refraction errors in azimuth determinations. The complexity of this problem is well known. It is suggested to place the corrections for refraction into the azimuths at Laplace stations according to the zenith distances measured simultaneously with the azimuthal designations. In this case it is necessary to know actual (more accurate) theoretical zenith distances. In this paper the theoretical part of the problem is calculated on a specific example. TAB

N69-14648# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
CONTRIBUTIONS FROM THE ENERGY TRANSFER GROUP
Sep. 1968 76 p refs
Avail: Issuing Activity

A series of articles on meteorology and oceanography is presented. These include integral methods for calculation of water vapor fluxes from the water surface; the effect of bottom topography and variable wind stress on ocean water movement; and an aerodynamic theory of wave growth with constant wave steepness. Other papers in the series concern the direct determination of turbulent heat flux near the ground; the distinction between total heat flux and eddy heat flux; and heat flux effects on the atmospheric turbulence spectra over land. D.H.B.

N69-14690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHASE DISTORTIONS OF REFLECTIONS AT SHORT TIMES IN GROUPED DETONATIONS
V. V. Koryagin et al 13 Nov. 1967 11 p refs Transl. into ENGLISH from Razved. i Promysl. Geofiz. (Moscow), no. 13, 1966 p 25–32
(AD-677261; FTD-HT-23-1283-67) Avail: CFSTI CSCL 8/11

Experiments are described which were conducted during group shooting seismic prospecting operations in the Kuybyshev region to determine the phase distortions of waves reflected from a shallow (the uppermost) interface. To evaulate the distortions in instances involving different parameters in the grouping of shots, theoretical seismograms were compiled. TAB

N69-14716# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
STUDIES ON THE GENETIC RELATIONS BETWEEN THE THERMAL FIELD AND THE STRUCTURE AND DEVELOPMENT OF THE EARTH'S CRUST [ISSLEDOVANIYA GENETICHESKIKH SVYAZEI TEPLOVOGO POLYA SO STROENIEM I RAZVITIEM ZEMNO KORY]
Ya. B. Smironov Sep. 1968 15 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Geol. (USSR), v. 177, no. 1, 1967 p 182–184
(AD-677180; ACIC-TC-1430) Avail: CFSTI CSCL 8/7

The spatial distribution of the thermal field and its relations with the structure of the earths crust and separate geological and geophysical parameters have been analyzed on the basis of results obtained from measuring the abyssal thermal current. In this study, the uniformity of selecting the thermal current in tectonic regions is based on geophysical indexes. The uniform selections used have been analyzed by mathematical statistics which made it possible to explain reliable mean value estimates of the thermal current and the probability of deviation of various tectonic regions. The obtained results of distributions have been compared against each other by the Fisher-Student methods, and as a result zones similar with respect to energy have been exposed. There are various tables and maps showing the various results of this investigation. Author (TAB)

N69-14725# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
STUDIES IN LOW-ORDER SPECTRAL SYSTEMS
F. Baer Aug. 1968 81 p refs /rs Atmospheric Sci. Paper No. 125
(Grant NSF GA-761)
Avail: Issuing Activity

A low-order system of spectral equations, representing in some measure the physical properties of the atmosphere, has been shown to apply to both barotropic and baroclinic flows. The system allows for an arbitrary zonal flow and one planetary wave with no approximations for spherical geometry. The analytic solutions in terms of elliptic functions are described, and the required initial conditions are clarified. The energetics of both barotropic and baroclinic flows for the low-order truncation are discussed. A Fjortoft type theorem for baroclinic energy exchange is developed. The applicability of linear analysis to the nonlinear equations is shown, and correspondence to the true solution is established. Some barotropic calculations show a remarkable variety of energy exchenges, depending on initial conditions and truncation. Author

N69-14740# Ohio State Univ., Columbus. Dept. of Geodetic Science.
COMPARISON OF TWO METHODS FOR THE COMBINATION OF SATELLITE AND GRAVIMETRIC DATA Interim Report
Richard H. Rapp Jul. 1968 44 p refs
(Contract AF 19(628)-5701)
(AD-676978; AFCRL-68-0386; REPT-113; SR-22) Avail: CFSTI CSCL 8/5

One method for the combination of satellite and gravimetric data consists of a comparison of a potential coefficient found by satellite analysis with the coefficient found by the usual summation process applied to a global estimate of a terrestrial anomaly field. A second method compares an anomaly computed from a set of potential coefficients found from satellite analysis with the observed terrestrial estimate. The specific equations for the adjustment procedure are derived and compared. Author (TAB)

N69-14744# Arizona Univ., Tucson. Geochemical Section.
CORRELATION AND CHRONOLOGY OF ORE DEPOSITS AND VOLCANIC ROCKS Annual Report
Paul E. Damon Jun. 1968 75 p refs
(Contract AT(11-1)-689)
(COO-689-100) Avail: CFSTI

New equipment and methods improvements are described for analyses of argon, potassium, rubidium, strontium, and naturally occurring radioisotopes. High-temperature argon introduction experiments have continued. The dating of ore deposits of areas in the United States is discussed from these and previous experiments. K–Ar dating procedures, analyses, and the accompanying factors of volcanic rocks are presented. Geological and geochemical investigations of samples from southeastern Arizona and the Del Bac Hills are reported. Measurements of magnetic polarity on samples collected for dating are reported for late Oligocene–early Miocene time. New K–Ar dates are tabulated on samples from the Basin and Range Province areas and late Cenozoic basalts from the Colorado Plateau. Dating of samples from Questa, New Mexico, Tintic Mining District, Utah, Caribbean volcanic rocks, Kiwira basalt, Tanzonia, and Hagen–Tonstein sanidine is discussed. NSA

N69-14773*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DETAILED ANALYSIS OF RADIATION DATA FROM THE GEMINI 4 AND GEMINI 7 PROTON-ELECTRON SPECTROMETER EXPERIMENTS Final Report, 13 Jun. 1967–30 Dec. 1968
J. B. Reagan, M. A. Heinemann, J. C. Bakke, and W. L. Imhof 30 Dec. 1968 96 p refs
(Contract NAS9-7030)
(NASA-CR-92444; LMSC-682411) Avail: CFSTI CSCL 04A

The results of the data analysis performed on information obtained from two radiation spectrometer experiments conducted on the Gemini IV and Gemini VII spacecraft in June and December 1965 are described. Omnidirectional fluxes and spectra of electrons in the 0.45 to 6.0 MeV energy range and of protons in the 23.5 to 80 MeV energy range as well as the omnidirectional proton flux greater than approximately 64 MeV were measured by scintillation spectrometers employing 16-channel pulse-height analyzers. Omnidirectional fluxes of both electrons and protons as a function of the magnetic field intensity, B, for specific L shells are presented along with the resulting flux contours in B,L space. Detailed electron and proton spectra as a function of L shell are also presented. Comparison of the present results with both theoretical and other experimental results is included. A direct measurement of the flux and spectra of the East-West asymmetry of trapped protons at low altitudes was performed on the Gemini IV experiment. A discussion of this measurement and its implications on the source and decay of trapped protons in the inner radiation belt is also presented. Author

N69-14778*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
RECENT ROCKET MEASUREMENTS OF AC ELECTRIC AND MAGNETIC FIELDS IN THE IONOSPHERE
Stanley D. Shawhan and Donald A. Gurnett Stockholm Royal Inst. of Tech. 1968 20 p refs Presented at the NATO Advan. Study Inst., Roros, Norway, 17–26 Apr. 1968
(Contract NSR-16-001-025; Grant NGR-16-001-043; Contract Nonr-1509(06))
(Rept.-68-07) Avail: CFSTI CSCL 04A

A summary of the AC electric and magnetic fields observed in the ionosphere by the Javelin 8.45 UI sounding rocket launched from Wallops Island, Virginia, on 21 September 1967 is presented. The electric dipole and magnetic loop antenna systems and the VLF (30 Hz - 70 kHz) receivers are described. Data on the spectral characteristics, the noise amplitude, and the wave field geometry for two types of noise are summarized. A high frequency electromagnetic noiseband occurred between 7 kHz and 30 kHz throughout the flight. Marked spectral changes with altitude, a large ratio of electric to magnetic field amplitude and a field geometry which indicates that the noise is propagating perpendicular to the geomagnetic field was observed. It is argued that the lower cutoff frequency may be the lower hybrid resonance frequency. Precession modulated intense noise bursts were observed on the electric antennas only. This electrostatic noise occurred below 1 kHz in frequency and below 500 km in altitude both upgoing and downgoing. From the spectral shape, the phase of the noise amplitude with respect to the component of velocity perpendicular to the geomagnetic field and the relative electric field amplitudes, it appears that this noise may be caused by a turbulent wake of the payload. Author (ESRO)

N69-14783# Royal Aircraft Establishment, Farnborough (England).
THE SEMI-ANNUAL VARIATION IN AIR DENSITY AT A HEIGHT OF 1100 KM FROM 1964 TO 1967
G. E. Cook and Diana W. Scott Jul. 1968 23 p refs
(RAE-TR-68162) Avail: CFSTI

The orbit of Echo 2 is used to derive values of exospheric density at heights near 1100 km during 1967. The results are combined with those from two earlier studies to show the behavior of the semi-annual variation at solar minimum and throughout the entire rising phase of the current solar cycle. The July minima are consistently deeper than the January minima, while there is no systematic difference between the April and October maxima. It appears that the ratio of the mean maximum density to the mean minimum in the semi-annual variation decreased from about 2.5 in 1964 to about 1.8 (or possibly even lower) in 1966, as the 10.7 cm radiation flux increased from 70 to 120×10^{-22} $Wm^{-2}HZ^{-1}$, and the ratio then increased slightly to about 2.0 in 1967. Author (ESRO)

N69-14803*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
CHANGES IN THE UPPER IONOSPHERE DURING SEVERE MAGNETIC STORMS
D. G. Mack 30 Sep. 1968 98 p refs
(Grants NGR-39-009-095; NSF GP-5611)
(NASA-CR-98707; SR-325) Avail: CFSTI CSCL 04A

Employing ionograms from the Alouette I topside sounder satellite, the moderately severe magnetic storms of June 15, 1965 and March 8, 1963 were investigated. Latitudinal contours of N(e) and vertical scale height revealed the disappearance of the geomagnetic anomaly during high magnetic activity, with a distinct correlation between Kp and the collapse of the anomaly being suggested. Storm-time variations of N(e) were found to be dependent upon the phase of the magnetic storm. Consistently reduced values of the storm-time vertical scale heights were interpreted as indicating an increase mean ionic mass due to an increased mixing of the ionosphere. Author

N69-14807*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEUTRAL PARTICLE WAKE EXPERIMENT FOR MEASURING UPPER ATMOSPHERE TEMPERATURES FROM A MOVING VEHICLE
L. H. Brace and W. C. Wu Nov. 1968 28 p refs
(NASA-TM-X-63424; X-621-68-397) Avail: CFSTI CSCL 04A

A method is discussed for measuring the kinetic temperature of the neutral particles in the upper atmosphere. A suitable baffle is mounted an appropriate distance in front of the orifice of a satellite-borne neutral particle mass spectrometer. At atmospheric temperatures, the baffle produces a pressure reduction which varies approximately inversely with the temperature. Since the various neutral particle species have different thermal velocities, each will independently produce its own wake. The baffle performs a kind of mass discrimination in which the lateral components of thermal motion cause the lighter species to form the near-wake and the heavier species to form a more extended wake. Thus, at any given distance behind the baffle, a greater pressure reduction is observed for the heavier species. When chemically active species such as atomic oxygen are sampled the depth of modulation will still reflect the temperature, but the absolute amplitudes of the pressure inside the chamber will depend upon the amount of recombination. When mixtures of atomic and molecular species are presented in the atmosphere, this technique provides an additional source of information regarding the relative concentrations of the atomic and molecular species. Author

N69-14829# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.
EFFECTS OF FIELD-ALIGNED CURRENTS ON THE STRUCTURE OF THE IONOSPHERE
L. P. Block and C. G. Fälthammar May 1968 18 p refs
(Rept.-68-10) Avail: CFSTI

The influence of electric currents along the magnetic field lines on the high-latitude F-layer ionosphere is investigated theoretically. It is shown that a current of either sign leads to a reduction of the total electron content and the maximum density, if the charge carriers have to be produced in the ionosphere. Low energy precipitation leads to a corresponding increase. Extremely low densities in the topside ionosphere may be reached for ion currents of the order of 10^{-8} amps/m^2 or electron currents of 10^{-3} amps/m^2. Observational evidence exists for currents at least of the order of 10^{-6} amps/m^2. It is suggested that the ionospheric trough, the F-layer storm and other similar effects may be explained by field-aligned currents or plasma diffusion, which is also quantitatively accounted for by the present theory. Author (ESRO)

N69-14862*# Volt Information Sciences, Inc., Washington, D. C.
SECOND EXPERIMENT ON THE INVESTIGATION OF ION-MOLECULAR REACTION CONSTANTS DIRECTLY IN THE IONOSPHERE
A. D. Danilov et al Greenbelt, Md. NASA. Goddard Space Flight Center 18 Dec. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofiz. (USSR), v. 183, no. 2, 1968 p 326-328
(Contract NAS5-12487)
(NASA-CR-98723; ST-AM-AI-10786) Avail: CFSTI CSCL 04A

A new and improved experiment, involving, besides the basic ion-molecular reactions, a new set of reactions which participate in the formation of NO^+ and O_2^+ ions at the expense of neutral molecules O_2 and N_2 is described. Good agreement is shown with Fehsenfeld data relative to the ratio γ_2/γ_1, thus far considered to be the most reliable. The apparatus installed aboard the geophysical rocket performing the experiment is described. Author

N69-14876 Stanford Univ., Calif.
THE PIEZOMAGNETIC EFFECT IN SEISMICALLY ACTIVE AREAS
Sheldon Breiner (Ph.D. Thesis) 1967 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-6395

The piezomagnetic properties or magnetostrictive effects of rock under stress have been widely discussed and experimentally observed in the laboratory. The results of these investigations indicate that a change in the subsurface stress should manifest itself as a change in the susceptibility and remanent magnetization of rock and therefore in the local geomagnetic field. Observations of the geomagnetic field on the surface of the earth might thus represent a means for the remote observation of changes in tectonic stress. The local change in field intensity, or piezomagnetic anomaly, is a function of the stress change, magnetic susceptibility, and the volume and distance to the rock under stress. The stress dependence can be expressed as a decrease of a few percent in the susceptibility and remanent magnetization in the direction of a compressive stress of 100 kg/cm^2 and a somewhat larger increase at right angles to this stress. Dissert. Abstr.

N69-14916*# Volt Information Sciences, Inc., Washington, D. C.
CURRENTS OF QUASITRAPPED PARTICLES AND THEIR INTERACTION WITH THE GEOMAGNETIC FIELD (SYMMETRICAL APPROXIMATION)
V. D. Pletnev and O. A. Troshichev Greenbelt, Md. NASA. Goddard Space Flight Center 27 Dec. 1967 19 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 5, 1968 p 707-719
(Contract NAS5-12487)
(NASA-CR-98721; ST-PF-GM-10788) Avail: CFSTI CSCL 04A

A model is investigated of symmetrical (ring) current of quasitrapped particles at high latitudes inside the magnetosphere. Also calculated are the different particular cases of particle distribution in the current, corresponding to the anisotropic form. The distribution along the latitude of current density, and its influence on the geomagnetic field are estimated. It is shown that the main phase of the magnetic storm may be explained by the interaction of the current of quasitrapped particles with the field of the magnetosphere. Author

N69-14922*# Volt Information Sciences, Inc., Washington, D. C.
TRANSFORMATION OF THE ELECTRIC FIELD AT PROPAGATION OF ACOUSTIC WAVES AND THEIR TRANSITION INTO PLASMA WAVES
Yu. M. Nikolayev Greenbelt, Md. NASA. Goddard Space Flight Center 23 Dec. 1968 13 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 6, 1968 p 1031-1038
(Contract NAS5-12487)
(NASA-CR-98722; ST-WP-AI-10787) Avail: CFSTI CSCL 04A

The question of excitation theory of electric fields during a nearly vertical upward propagation of an acoustic wave at altitudes corresponding to that of the F_2-layer of the ionosphere is considered. The occurring charge division conditions the transformation of the electric field in the form of a circularly polarized wave. The transformation of the electric field in height is investigated in such a wave. A system of plasma equations is proposed, taking into account the neutrals, whose motion is given in the form of a propagating viscous acoustic wave. The conclusions of theory are utilized for the interpretation of regularities linked with the peculiarity in the propagation of electric fields. An estimate is given of the effectiveness of inhomogeneity formation, taking into account the dependence of electron and ion concentration with height. Author

N69-14948# Royal Aircraft Establishment, Farnborough (England).
FURTHER DETERMINATIONS OF UPPER-ATMOSPHERE ROTATIONAL SPEED FROM ANALYSIS OF SATELLITE ORBITS
D. G. King-Hele and Diana W. Scott Aug. 1967 37 p refs Presented at the COSPAR Symp., London, Jul. 1967
(RAE-TR-67179) Avail: Issuing Activity

The average angular velocity of the upper atmosphere, taken as Λ times the Earth's angular velocity, can be evaluated by analyzing the changes in the orbital inclinations of satellites. In this paper the nine most suitable orbits now available are analyzed and values of Λ are found for heights between 200 and 260 km. The results, which are more accurate than in our previous studies, confirm that $\Lambda > 1$, i.e. that the atmosphere rotates faster than the Earth at these heights, and show that Λ increases with height, from 1.1 at 210 km to 1.4 at 260 km. This corresponds to mean west-to-east winds of 30 m/s at 210 km, increasing to 130 m/s at 260 km height. Results from one satellite indicate that the wind is probably strongest at times near sunset, with $\Lambda = 1.5 \pm 0.1$ at 200 km height in August 1966. Comparisons are made with previous observational results. Suggested theoretical explanations are outlined. Author

N69-14953# International Training Centre for Aerial Survey, Delft (Netherlands).
IN SEARCH OF METALS. PUBLIC LECTURE
Sietze Dijkstra [1968] 21 p refs
Avail: Issuing Activity

Some of the problems related to the geology of ore deposits are outlined, and summary data are presented on several common methods used in the search for ore. These include geophysical methods for systematic measurements of some physical quantity at the earth's surface to acquire information on the possibility of mineralization at depth; and geochemical methods of exploration for determining trace element distributions in naturally occurring materials, such as water, stream sediments, soils, rocks, and vegetation. It is pointed out that the application of air photographs might be extended by recent developments in full color and false color photography. Thermal mapping, using infrared scanning techniques, are also regarded as a potential method for locating oxidation zones of sulfide deposits which are covered by a not-too-thick overburden. M.G.J.

N69-14954# Southwest Center for Advanced Studies, Dallas, Tex.
REINTERPRETATION OF GEOCORONAL OBSERVATIONS WITH INCREASED HIGH/LOW ALTITUDE HYDROGEN RATIO
Brian A. Tinsley Oct. 1968 12 p refs Submitted for publication
(Grant NSF GA-1341)
Avail: Issuing Activity

Vertical profiles of atomic hydrogen with a greater ratio of high/low altitude hydrogen than used in the past for interpreting optical observations were shown to render them more consistent with each other, with theoretical models of diurnal variations, and with other evaluations of hydrogen number density. The required profile could result from the effects of molecular hydrogen number densities being greater than atomic hydrogen number densities of the 100 km level. However other mechanisms to alter the altitude profile are possible, and one such has been suggested where a source of high altitude hydrogen arises from solar wind plasma coming into the polar regions through the geomagnetic tail. The increase of the ratio of high/low altitude hydrogen required to best explain the observations may be as much as an order of magnitude. A direct measurement of the altitude profile of H from 100 km up to say 500 km is obviously very desirable. Probably the best approach would be an extension to higher altitudes of the Purcell and Tousey (1960) solar Lyman α line measurement, with efforts made to increase the accuracy of the determination. Author

N69-14977# Chalmers Univ. of Tegy, Goteborg (Sweden). Hydraulic Div.
HYDRAULICS OF MARINE WASTE WATER DISPOSAL
Klas Cederwall Jan. 1968 279 p refs Supported in part by Natl. Board of Roads
(REPT-42) Avail: CFSTI

Various aspects of turbulent diffusion related to water pollution problems are studied. Basic features of turbulent flow and exchange processes are reviewed. The main emphasis is on mixing due to jet diffusion and turbulent diffusion and dispersion in natural waters. Author

N69-14986# Wilkes Coll., Wilkes-Barre, Pa. Dept. of Physics.
DIURNAL WIND VARIATIONS IN THE STRATOSPHERE Final Report, 1 Jan. 1965–31 Dec. 1967
Alvan Bruch, Jae-Hyoung Park, Louis M. Pecora, Martin A. Yencha, and John J. Cupani Mar. 1968 137 p refs
(Contract AF 19(628)-4795)
(AD-677007; AFCRL-68-0373) Avail: CFSTI CSCL 4/2

The Butler-Small model is solved for wind fields. The effect of secondary temperature variation, due to adiabatic expansion and compression associated with the tidal oscillation, is studied to see if it might be additive to the primary variation due to ozone absorption. It is found to be out of phase and reduces rather than enhances the diurnal temperature variation, although the complete analysis using negative eigenvalues of the equivalent depth for the diurnal variation is not attempted. The harmonic analysis of MRN wind data for North American sites is attempted using standard analysis techniques at WSMR, AMR, and Wallops Island. A folding technique is employed at PMR, Fort Churchill, and Fort Greely to obtain estimates of the harmonic coefficients despite the fact that data are virtually non-existent during the night at these sites. Author (TAB)

N69-15010*# Volt Information Sciences, Inc., Washington, D. C.
ANALYSIS OF NIGHT SKY EMISSIONS ACCORDING TO OBSERVATIONS ON AES KOSMOS-92
V. A. Krasnopol'skiy Greenbelt, Md. NASA. Goddard Space Flight Center 30 Dec. 1968 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 6, 1968 p 1063–1067
(Contract NAS5-12487)
(NASA-CR-98728; ST-AA-AM-10791) Avail: CFSTI CSCL 04A

Two components have been isolated during the night sky flare observed on AES "KOSMOS-92": one of them constitutes a proportional enhancement of all the standard components of atmosphere luminescence; the second apparently includes a γ-system of NO bands and the attending radiation. The question of the probable source of these emissions is discussed. Author

N69-15013# Finnish Meteorological Office, Helsinki.
RESULTS OF SOIL TEMPERATURE MEASUREMENTS AT JOKIOINEN OBSERVATORY, 1957–1963
Jun. 1968 32 p refs
(REPT-1) Avail: CFSTI

This volume contains results of soil temperature measurements made at Jokioinen meteorological observatory during the years 1957–1963. The geographical coordinates of the observatory are 60°49' N and 23°30' E and its height above mean sea level is 103 m. The soil of the field is heavy clay. The depth of the clay layer at the site is 4.2 m and underneath it there is coarse gravel. The field is drained. Soil temperature measurements were made on the middle line between two drains. The site was covered with short grass. Determinations of the physical properties of the soil in the topmost layer of about 50 cm thickness have been made. According to the results the soil moisture content has been observed to change between the values 0.25 and 0.60 g cm^{-3}. In the state of field capacity the moisture content was 0.49–0.53 g cm^{-3} and the heat conductivity 0.0018–0.0020 cal cm^{-1} sec^{-1} $°C^{-1}$. In perfectly dry soil the density was found to be 1.15–1.20 g cm^{-3} and the heat capacity 0.21–0.23 cal cm^{-3} $°C^{-1}$. Author

N69-15016# Department of Mines and Technical Surveys, Ottawa (Canada). Observatories Branch.
SEISMOLOGICAL BULLETIN, JANUARY–DECEMBER 1967
1968 324 p
(REPT-1967-1) Avail: CFSTI

The P-phase recordings obtained at the seismological stations of Canada are listed. Calibration curves for all the various seismographs operated at the stations are presented, and computer listings of the P phase recorded at the stations are given. F.O.S.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N69-13931# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
ANNUAL REPORT FOR 1967 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME 2: PHYSICAL SCIENCES. PART 1: INSTRUMENTATION
W. G. Spear Jun. 1968 86 p refs
(Contract AT(45-1)-1830)
(BNWL-715-pt-1; UC-49) Avail: CFSTI

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7. DEVELOPMENTAL EVALUATION OF MINIATURE BIOLOGICAL SENSING TRANSDUCERS R. L. Wilbur p 44–48 (See N69-13938 04-04)

8. SURFACE TENSION INSTRUMENT R. L. Wilbur p 49–53 refs (See N69-13939 04-04)

9. NEUTRON AREA MONITOR FOR THE POSITIVE ION VAN DE GRAAFF GENERATOR FACILITY E. M. Sheen and C. A. Ratcliffe p 54–60 (See N69-13940 04-14)

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N69-13940# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
NEUTRON AREA MONITOR FOR THE POSITIVE ION VAN DE GRAAFF GENERATOR FACILITY
E. M. Sheen and C. A. Ratcliffe *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 54–60 (See N69-13931 04-14)
Avail: CFSTI

This report describes electronic instrumentation to be used with a moderated neutron proportional counter tube as an area monitor for the PNL positive ion Van de Graaff generator. The monitor comprises an adjustable high voltage power supply, a count rate meter readout, and an alarm with adjustable threshold. The alarm consists of blinking lights and a pulsed acoustic annunciator. Author

N69-13941# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
IMPROVEMENTS IN RAINDROP CHARGE MEASURING SYSTEM
C. A. Ratcliffe and N. C. Hoitink *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., vol. 2, pt. 1 Jun. 1968 p 61–64 refs (See N69-13931 04-14)
Avail: CFSTI

Improvements incorporated into the raindrop charge measuring system used in atmospheric studies reduced transducer microphonics, improved charge induction geometry, reduced adverse environmental operating characteristics, and increased the charge sensitivity to approximately 10^{-15} C. The use of an electrostatic pen recording method allowed system operating under adverse climatic conditions. Extensive field tests, on a continuing basis with power obtained by using batteries for the electronics and a portable ac generator for the recording equipment, evidenced marked operational improvement. Author

N69-13942# Bhabha Atomic Research Centre, Bombay (India).
PERFORMANCE OF A SINGLE BEAM ATOMIC ABSORPTION SPECTROPHOTOMETER
A. P. D'Silva and T. V. Venkitachalam 1968 22 p refs
(BARC-335) Avail: CFSTI

The performance of a simple atomic absorption spectrophotometer designed to determine trace impurities in high purity materials is described. This instrument operates on the single beam principle, with no facility for scale expansion, but still the limits of sensitivity obtained are comparable to the detection limits obtained in commercial instruments using scale expansion techniques. A cost estimate has shown that substantial saving in foreign exchange could be made if similar instruments are fabricated here. Author

N69-13958*# General Electric Co., Schenectady, N. Y. Research and Development Center.
DESIGN, DEVELOPMENT, FABRICATION AND DELIVERY OF FLUIDIC ACCELEROMETERS Final Report
28 Mar. 1968 64 p
(Contract NAS8-20729)
(NASA-CR-98181; S-88-1047) Avail: CFSTI CSCL 14B

Two fluidic accelerometers were designed, developed, and tested. The accelerometers are of the closed loop force balance type with a differential output pressure directly proportional to acceleration. The design specifications included a range of ± 1 g; air media filtered to 25 microns; operating temperature range from 0° to 350°F. The output pressure for an input of 1g will be at least 5 psig with a supply pressure of 20 psig. The device will have a structural capability of operating at 100 psig. The maximum flow rate will be 0.1 scfm or greater. The phase angle will be equal to or less than the phase lag of a linear second order system with a natural frequency of 80 cps and peaking of 1 db or greater. B.P.

N69-13973# Georgia Inst. of Tech., Atlanta. School of Chemistry.
MEASUREMENTS BY IMPROVED METHODS OF ACTIVATION CROSS SECTIONS FOR 14.4 MeV NEUTRON REACTIONS
R. W. Fink *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 30–47 refs Supported in part by AEC (See N69-13971 04-24)
Avail: CFSTI

The development of improved techniques for precision measurement of activation cross sections is reported. These new techniques take advantage of the high resolution of Ge(Li) detectors. For short-lived products, a fast pneumatic transport system (≈800 msec) is used, together with a digital tape recorder to store rapid, successive 400-channel spectra from rapidly decaying samples observed with a 16 cc Ge(Li) spectrometer. Precision cross sections for reactions of isotopes of Kr, Si, Zn, Br, Rb, Se, Fe, Ge, Cd, Pd, Hg, Tl, and Au will be tabulated. These values are being fitted into a revised system of cross section systematics, from which all questionable early data are excluded. Current work on Xe isotopes and other elements will be discussed. Improvements in the operation of a 200 KV accelerator will be reported, and its proposed use as a source of bremsstrahlung-free characteristic x-ray for atomic physics investigations and for high resolution (medical) x-ray photography will be pointed out. Author

N69-14028*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RESPONSE OF THE ION-ELECTRON DETECTOR FLOWN ON EXPLORER 12, AUGUST TO DECEMBER 1961

Leo R. Davis and Andrei Konradi Nov. 1968 520 p refs

(NASA-TM-X-63407; X-612-68-447) Avail: CFSTI CSCL 22B

Graphs are presented to depict the temporal history of the output of the ion–electron detector flown on Explorer 12. The satellite was launched on August 16, 1961 and ceased transmitting on December 6, 1961. It had a 33° inclination orbit with an apogee at 13 R_e which permitted it to cross the boundary of the magnetosphere twice on each orbit. Its orbital period was 26 1/2 hours. At launch the line of apsides was pointed in the direction of the sun. The detector was a scintillation counter consisting of a photomultiplier tube on the face of which is deposited a 5-mg/cm^2-thick layer of crystalline ZnS covered by a 1000 Å thick layer of Al. Author

N69-14060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DYNAMIC AND STATIC BALANCING OF GYROSCOPIC DEVICES

M. P. Kovalev et al 19 Jan. 1968 314 p refs Transl. into ENGLISH of the book "Dinamicheskoye i Staticheskoye Uravnoveshivaniye Giroskopicheskikh Ustroystv" Moscow, Mashinostr., 1965

(AD-677162; FTD-MT-24-309-67) Avail: CFSTI CSCL 13/8

The book presents the theory of balancing rotating parts of machines and instruments demonstrating the dependence of precision of dynamic balancing upon the quality of the support. Also, it analyses basic causes of vibrations and methods of their elimination. Explanations are given of the principles of action of balancing machines and their elements, and practical recommendations on the technique of constructing and balancing them are given. Author (TAB)

N69-14077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METALLIC CRYOSTAT FOR SUPERCONDUCTING SOLENOIDS

A. B. Fradkov 2 Nov. 1967 11 p refs Transl. of Transactions of the Conf. Presented at the Conf. on Metallography and Phys. of Metals in Superconductors, 1965

(AD-677216; FTD-HT-23-1071-67) Avail: CFSTI CSCL 20/12

The construction details of several cryostats are discussed. One of the cryostats is built to accommodate the solenoid as well as the test area within the helium-cooled cryostat. The other two have their test sections exposed to room temperature. The basic parts of all three cryostats are made of copper tubing and have an outer compartment filled with liquid nitrogen and an inner compartment filled with liquid helium. These compartments are made of stainless steel. An overall heat balance indicates that the total heat leakage into the system amounts to 560 joules/hour. A single-section solenoid placed in one of those cryostats can generate a field of 15 koe in a 52 mm gap with a critical current of 14-17 amps. It is contended that the above system is capable of yielding 50-60 koe magnetic fields. Author (TAB)

N69-14099# California Univ., Livermore. Lawrence Radiation Lab.

POCKET CELLS: THEORY, TEST PROCEDURES, CHARACTERISTICS

W. E. Adams 1 Aug. 1968 33 p refs

(Contract W-7405-eng-48)

(UCRL-50463) Avail: CFSTI

To optimize the performance of a Pockels cell one must understand the basics of cystallography, optical birefringence, and the electro-optic effect. The pertinent information is scattered inconveniently throughout the literature and is rarely directed to the use and understanding of Pockels cells. The essential theory necessary to understand the Pockels effect is presented, and simple test procedures that will indicate the characteristics of the cell are described. Practical problems that one must consider when using a Pockels cell are discussed. Author (NSA)

N69-14134# Kiel Univ. (West Germany).

DESCRIPTION OF A SPECTROMETER WITH SEMICONDUCTOR COUNTERS FOR PROTON AND ALPHA-PARTICLE MEASUREMENTS IN THE EARTH'S RADIATION BELT [AUFBAU UND WIRKUNGSWEISE EINES HALBLEITERSPEKTROMETERS ZUM NACHWEIS VON PROTONEN UND ALPHA-TEILCHEN IM STRAHLUNGS-GUERTEL DER ERDE]

G. Wibberenz, H. Fischer, and J. Boehm Sep. 1968 69 p refs In GERMAN; ENGLISH summary

(BMwF-FB-W-68-64) Avail: CFSTI

The function and the assembly of a semiconductor telescope for measuring proton and alpha particle spectra is described. The spectrometer has been proved successfully in two flights with Javelin-rockets launched from Natal (Brazil). The electronic design of the experiment is specified after a detailed discussion of the measuring method and some special properties of the detectors. Pulse shaping of the chargesensitive preamplifier is explained by a simple theory. Theroetical results are compared with corresponding experimental measurements. Author

N69-14156# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.

RADIATION BALANCE IN ROCKETSONDE THERMOMETERS Final Report, 16 Dec. 1964–29 Feb. 1968

Delbar P. Kelly Feb. 1968 11 p refs

(Contract AF 19(628)-4165)

(AD-677343; AFCRL-68-0410) Avail: CFSTI CSCL 4/2

The report summarizes the objectives, plan and results of work on the heat balance of wire supported bead thermistors in simulated 60 kilometer atmospheres, with references to project scientific reports and published papers for details. Author (TAB)

N69-14215# Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica.

STUDY OF SOME TECHNICAL PROBLEMS IN NUCLEAR EMULSIONS [ESTUDIO DE ALGUNOS PROBLEMOS TECNICOS EN EMULSIONES FOTONUCLEARES]

M. Pilar Tarrega Tornero 1967 21 p refs In SPANISH

(JEN-194-IFIC/I-58) Avail: CFSTI

A methodological study of various technical aspects of photographic emulsions is presented. Variation of different ionization indices with the degree of development is studied. A measure of the degree of development, called the α-mark, is based on the average width of tracks due to α-particles. Using the α-mark the influence of several factors such as the duration, temperature and

concentration of the developing liquid are investigated. A comparative study of the sensitivity of Ilford C2 and K2 emulsions is given. Also, the α-mark is used to study the influence of temperature and humidity on the speed of fading. Discrimination of high-energy particles by ionization measurements is discussed. By measuring the momentum and the relative ionization of very energetic particles, the effect of the developing liquid with depth in emulsion is studied. The results of different methods of development on the distortion of resin-treated emulsion are given. Author (NSA)

N69-14217# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
CONSTRUCTION AND ALIGNMENT OF A HIGH RESOLUTION BETA RAY SPECTROMETER
Joseph J. Ettter and W. L. Talbert Aug. 1968 59 p refs
(Contract W-7405-ENG-82)
(IS-1950) Avail: CFSTI

A high resolution beta-ray spectrometer is described which was constructed for the study of short-lived activities provided by an online isotope separator at the Ames Laboratory Research Reactor. Details of the construction of components of the spectrometer are presented, along with auxiliary equipment including the spectrometer field control and stabilizing systems. The procedure is described for alignment of the spectrometer in a high-aperture mode of operation. The performance of the aligned spectrometer is compared to a similar instrument at the University of Colorado. For the K-conversion line of the 329-keV transition in the decay of ^{198}Au, the spectrometer has a measured resolution of 0.12% for a luminosity of 1.66×10^{-3} cm^2 (0.28% of 4π transmission) and 0.17% for a luminosity of 7.08×10^{-3} cm^2 (1.21% of 4π transmission). Author (NSA)

N69-14286 Rensselaer Polytechnic Inst., Troy, N. Y.
INSTRUMENTATION DEVELOPMENT
In its Linear Accelerator Proj. 31 Mar. 1968 p 53-63 ref
(See N69-14280 04-24)
Avail: CFSTI

The linac remote data processing terminal, spark chamber development, rupture tests on mylar vacuum windows, and modifications to the large liquid scintillator tank are briefly discussed. NSA

N69-14287# United Kingdom Atomic Energy Authority, Harwell (England).
THERMOCOUPLES FOR HIGH-TEMPERATURE MEASUREMENT
M. Villamayor [1968] 76 p refs Transl. into ENGLISH from the French rept. CEA-R-3182 Submitted for publication
(AERE-TRANS-1095) Avail: Issuing Activity

The behaviour of pure tungsten/tungsten, 26% rhenium and tungsten, 5% rhenium/tungsten, 26% rhenium thermocouples designed to monitor the temperature in nuclear reactors is described. An attempt was made to define errors of measurement resulting from conditions of use, by finding the response time, drift as a function of time, and the effect of thermal shock. In order to ascertain changes in thermocouples under irradiation in an extended temperature range an in-pile study was undertaken, and the results of this study are described. Effects caused by nuclear transmutations led to a proposal for a new type of thermocouple of molybdenum/niobium alloys. Author (NSA)

N69-14344*# Northwestern Univ., Evanston, Ill.
THERMAL INFRARED IMAGERY IN URBAN STUDIES
Barry S. Weller Dec. 1968 33 p refs Prepared for the U.S. Geological Survey
(NASA Order R-09-020-024)
(NASA-CR-98598; NASA-135) Avail: CFSTI CSCL 13B

Imagery is examined which was generated over an urban area by an infrared scanning system operating in the 8 to 14 micron region. The techniques and the data are discussed in terms of their potential role in urban studies. Briefly discussed are also detection and measurement of infrared radiation of various materials, meteorological factors, and problems in utilizing ground truth data. K.W.

N69-14351*# Raytheon Co., Sudbury, Mass.
LASER DOPPLER VELOCITY INSTRUMENT
E. Rolfe, J. K. Silk, S. Booth, K. Meister, and R. M. Young Washington NASA Dec. 1968 332 p refs
(Contract NAS8-20413)
(NASA-CR-1199; R67-4450) Avail: CFSTI CSCL 14B

Analytical and experimental data are presented on the development of a laser Doppler velocity instrument for measuring gas velocity. The instrument measures the Doppler shift of light scattered from particles moving with the gas, using Mie (Raleigh–Gans) scattering. The velocity thus measured is independent of particle temperature. An experimental comparison of the hot wire anemometer with the laser Doppler velocity instrument demonstrated excellent correspondence between the two. Measurements of velocity up to approximately Mach 2 in the seven inch wind tunnel compared well with simultaneous velocity measurements using the existing conventional tunnel instrumentation. Measurements were made with a one watt argon laser, and with a 50 milliwatt helium–neon laser. Several methods of signal processing were investigated and an optimum design concept established. This consisted of a wide range narrow band frequency tracker, whose output can be directly recorded on tape to give all necessary information on turbulence and velocity. Author

N69-14374# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
AN EXPERIMENTAL STUDY TO DETERMINE THE UTILITY OF STANDARD COMMERCIAL HOT-WIRE AND COATED WEDGE-SHAPED HOT-FILM PROBES FOR MEASUREMENT OF TURBULENCE IN WATER-CONTAMINATED AIR FLOWS
Francis J. Merceret, Jr. Aug. 1968 26 p refs
(Contract Nonr-4010(11))
(AD-677048; TR-40) Avail: CFSTI CSCL 4/2

Tests were made to determine the response of hot-wire and wedge-shaped coated hot-film probes to liquid water-contaminated air flow. It was found that conventional hot-wire probes are not suitable for turbulence measurements in such flows, while the hot-film probes are suitable in certain situations. Probe contamination by salt encrustation would prevent effective use of either sort if the contaminating water were saline. Author (TAB)

N69-14409# Mound Lab., Miamisburg, Ohio.
MODIFIED MOISTURE ANALYZER FOR SOLID RADIOACTIVE MATERIALS
H. B. Kreider, Jr. 13 Sep. 1968 8 p
(Contract AT(33-1)-GEN-53)
(MLM-1554) Avail: CFSTI

Modifications to a commercially available, high temperature moisture analyzer have permitted moisture contents of radioactive samples to be determined without exposing either the operator or the electronic components of the instrument to radioactivity. Performance of the analyzer continues to meet the accuracy specifications of the manufacturer. Author (NSA)

N69-14429# Kiel Univ. (West Germany).
THE CONSTRUCTION OF A PROTON- AND ALPHA-PARTICLE-SPECTROMETER SUITED FOR ROCKET-FLIGHTS FROM A TECHNICAL POINT OF VIEW [UBER DIE TECHNIK BEIM AUFBAU EINES PROTONEN- UND ALPHA-TEILCHEN-SPEKTROMETERS FUR EIN RAKETENEXPERIMENT]

J. Boehm, H. Fischer, and G. Korfmann Sep. 1968 38 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-65) Avail: CFSTI

For rocket-borne experiments special requirements have to be met according to mechanical stability and to the reaction of the experiment on environmental conditions. These requirements can be fullfilled to a considerable extend by a suitable construction of the mechanical and electronical parts and by means of a special integration technique of the electronic boards into the mechanical structure. Starting from the functional diagram of the electronics and from the functional diagram of the electronics and from physical considerations in connection with the detector arrangement a special construction was designed for a proton- and alpha-particle-spectrometer, which was expected to meet the above mentioned requirements. The total weight of the experiment was 2,540 g, the power consumption about 300 mW. Protons and alpha-particles with energies between 5 and 50 MeV/nucleon can be measured. The experiment participated successfully on two rocket flights with maximum altitudes of about 1,000 km. Author

N69-14458# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SELF-CORRECTING DOUBLE-IMAGE RANGE FINDER
A. I. Zakharov 14 Dec. 1967 5 p Transl. into ENGLISH from Russian Patent no. 180814 (Appl. no. 1004356/26-10, 20 Apr. 1965) 2 p
(AD-677227; FTD-HT-23-1112-67) Avail: CFSTI CSCL 17/8

The author certificate presents a self-correcting double-image range finder with a variable instrument base. The latter is formed of two movable pentagonal prisms placed symmetrically in respect to the objective of the viewer tube, and of wedge-shaped compensators producing the parallax angle. To correct automatically the magnitude of this angle in measuring the slope distances without using a rod and to simplify the construction of the apparatus, the wedges of the compensator are rigidly attached to the body of the range finder. They retain their position in respect to the horizon when the viewing tube is inclined. TAB

N69-14486# Stanford Univ., Calif. High Energy Physics Lab.
CHARGE COLLECTION EFFICIENCIES FOR LITHIUM-DRIFTED SILICON AND GERMANIUM DETECTORS IN THE X-RAY ENERGY REGION
H. R. Zulliger and D. W. Aitken Feb. 1968 19 p refs
(Contract AF 49(638)-1499)
(AD-677011; AFOSR-68-1676) Avail: CFSTI CSCL 18/4

Theoretical calculations showing the charge collection efficiencies of Ge(Li) and Si(Li) planar detectors as a function of trapping lengths and incident X-ray energies are presented. It is demonstrated that there should be an intrinsic energy dependence of the charge collection efficiency for radiation lengths comparable to the detector depletion depth. The nonlinear behavior is generally greater for unequal hole and electron trapping lengths. Experimental results confirm this in part, but surface effects appear to accentuate the effect. It is concluded that, neglecting surface effects, the nonlinearities should be eliminated if the radiation is incident in a direction perpendicular to the field. Highest charge collection efficiency, best resolution and linearity are obtained by injecting the photons through the detector side (perpendicular to the field) along a unique plane which is defined by the electron to hole trapping ratio. Author (TAB)

N69-14489# Massachusetts Univ., Amherst. Polymer Research Inst.
DYNAMIC X-RAY DIFFRACTOMETER FOR MEASURING RHEO-OPTICAL BEHAVIOR OF CRYSTALS IN POLYMER SOLIDS
Tatsuro Kawaguchi, Daniel A. Keedy, Richard S. Stein, Taisuke Ito (Kyoto Univ.), and Takashi Oda (Kyoto Univ.) Sep. 1968 49 p refs Prepared in cooperation with Kyoto Univ.
(Contract Nonr-3357(01))
(AD-677641; ONR-TR-107) Avail: CFSTI CSCL 7/4

A dynamic x-ray diffraction technique to follow the responses of polymer crystals, one of the structural units of crystalline high-polymeric materials, to mechanical excitation of sinusoidal strain induced to bulk specimen, is described. The descriptions for such responses are made in terms of the in-phase and out-of-phase components of the diffracted intensity by the crystals. From these, one may obtain the change in orientation of reciprocal lattice vector and deformation of lattice spacing of specific crystal planes with the change in the external periodic strain. The photoelectric switching circuits are described which activate repetitively four sets of scalers to count the continuously fed signals of the detected x-ray at particular strain phase intervals for each. The dynamic diffraction by the crystals can be evaluated by comparing the accumulated intensities among the four scalers. Author (TAB)

N69-14574# Little (Arthur D.), Inc., Cambridge, Mass. Research and Development Div.
DEVELOPMENT OF A THREE AXIS LONG-PERIOD SEISMOGRAPH Annual Report
Ivan Simon, M. L. Cohen, A. G. Emslie, R. K. McConnell, C. R. Smallman et al 31 May 1968 87 p
(Contract F44620-67-C-0107; ARPA Order 1029)
(AD-677009; C-69429; AFOSR-68-2152) Avail: CFSTI CSCL 8/11

Development of a three-component long-period borehole seismometer of small diameter /5-1/2 inches O.D./ is described. The feasibility of the magnetic suspension principle has been demonstrated and several instruments were constructed and tested in the laboratory. Author (TAB)

N69-14653# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
MEASUREMENT OF LINES IN POLYGONOMETRIC OPERATIONS WITH LENGTH FINDER AD-1 [IZMERENIE LINII V POLYIGONOMETRICHESKIKH KHODAKH DLINOMEROM AD-1]
E. I. Rykhlyuk, I. V. Zebode, V. Sh. Krongauz, and N. N. Nikolaev Sep. 1968 10 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 3, 1966 p 35–38
(AD-677183; ACIC-TC-1455) Avail: CFSTI CSCL 8/5

The translation is a description of the length-finder AD-1 and the method used in finding the measurement of lines in first and second order polygonometry. Without this instrument it is necessary to use graduated tapes and steel or Invar wires and a great amount of field work in laying out, fastening, and leveling of intermediate points. The AD-1 length finder consists of a calibrated measuring disc enclosed in a duraluminum frame, with a counting register and a braking device. Fastened to the frame of the instrument, on one surface are two directing rollers with thin grooves, by means of which the wire in its tense condition leads to the measuring disc and wraps around it. The axis of the rollers and the measuring disc rotate freely on ball-bearings. There are two slots in the frame for inserting the wire into the instrument. Two indexes may be brought into coincidence with points. The length-finder weighs about 2.2 kg. The essence of the method used consists of the determination of the length of an unstandardized steel wire, which is stretched beforehand between fixed points. The determination is accomplished by moving the length-finder along the wire, as a result of which the length of the line is automatically measured. It has been established that the method can be recommended for measurement of lines in first and second order traverse, and also in theodolite traverse. It completely eliminates the necessity of laying out, fastening and leveling intermediate points on the lines. TAB

N69-14669*# Electro-Optical Systems, Inc., Pasadena, Calif.
FEASIBILITY STUDY FOR DOUBLE-FOCUSING MASS SPECTROGRAPH Final Progress Report, 1 Apr.–1 Sep. 1968
L. Taylor 10 Dec. 1968 58 p refs
(Contract NAS9-7843)
(NASA-CR-92438; EOS-3039-FINAL) Avail: CFSTI CSCL 20F

Optimal parameters were determined for the design of an astronaut-operated double-focusing mass charge spectrograph for the measurement of solar wind mass/charge number composition. The parameters were specifically analyzed for their interdependence in order to establish an overall design approaching the following primary set of operating criteria: (1) resolution from 1000 to 5000; (2) mass/charge range from 2 to 10; (3) angular spread of $\pm 10^{\circ}$; and (4) velocity deviation of ± 0.20. It was found that attaining the angular spread is inconsistent with the remaining criteria, and that energy deviation is much more restricted than velocity deviation. Also considered was the following set of secondary criteria: (1) a degree of sensitivity appropriate for use of the instrument; (2) light flux rejection from 10^{-7} to 10^{-9}; (3) dimensions 15 × 15 × 45 cm; (4) weight <20 lb; and (5) power from 10 to 20 W.
K.W.

N69-14684# European Atomic Energy Community, Ispra (Italy).
DEVICE FOR BURN-OUT DETECTION WITH LOCALIZATION FOR DC-HEATED INDIVIDUAL PIPES AND BUNDLES [GARAET ZUR BURNOUT-DETEKTION MIT ORTUNGSMOEGLICHKEIT FUER GLEICHSTROMBEHEIZTE EINZELROHRE UND ROHRBUEBDEL]
P. Herzberger Oct. 1968 15 p In GERMAN
(EUR 4062d) Avail: CFSTI

Description of an electronic equipment for burn-out detection with possibility of its location. The apparatus can be used for rod bundles. In the case of 6 tubes it is possible to localize in two parts, for a single tube in 12 parts. The localization is indicated by a light signal. Contemporaneously the system is used to protect the tube or the bundle commanding a high speed circuit breaker which cuts down the main power.
Author

N69-14778# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Satellites Div.
STABILIZATION SYSTEM FOR THE DIADEME SATELLITE [SYSTEME DE STABILISATION DU SATELLITE DIADEME]
A. Alouges 6 May 1968 20 p In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

A stabilization system has been developed for the DIADEME satellite based on geomegnetic field action on a dipole on the satellite and a hysteresis damping. The size to be given to the dipole is discussed as well as the damping characteristics of the system. A numerical analysis and a simplified analog simulation are discussed. Results are given as gained with the model and in flight.
ESRO

N69-14813*# Perkin-Elmer Corp., Pomona, Calif.
TWO GAS ATMOSPHERE SENSOR SYSTEM Final Report [1968] 28 p
(Contract NAS1-8192)
(NASA-CR-66718) Avail: CFSTI CSCL 06K

The system described in this report is capable of monitoring helium, water vapor, nitrogen, oxygen, argon, and carbon dioxide in a closed laboratory cabin atmosphere and is designed to form an integral part of an atmospheric control loop. A theoretical ion focusing analysis, laboratory test data, and system operating instructions are presented.
K.W.

N69-14819# European Atomic Energy Community, Geel (Belgium). Joint Nuclear Research Center.
A SPARK CHAMBER FISSION FRAGMENT DETECTOR
E. Migneco, J. P. Theobald, and M. Merle Oct. 1968 19 p refs
(EUR-4077-e) Avail: CFSTI

A study of the properties of a wire-to-plane spark chamber as fission fragment detector discriminating against less ionizing radiation is reported.
Author

N69-14888# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
EXPERIMENTAL STUDY OF NEUTRON DETECTORS FREQUENCY RESPONSES
A. I. Mogilner, L. P. Krivelev, S. A. Morosov, and D. M. Shvetsov *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 161–180 refs (See N69-14878 04-22)
Avail: CFSTI

The application of many statistical methods in supplement to reactor technique requires the knowledge of the frequency response of used detectors. In literature there are both theoretical and experimental data dedicated to this question. Similar work was performed in the Institute of Physics and Power. The frequency responses of different gas-filled and solid covered counters and chambers were measured. The measurements were performed with the help of a Po-Be neutron source. For all detector types frequency responses as a function of the applied potential were obtained. For the fission chamber frequency characteristics as a function of the pressure of the gas-filled mixture were defined. The investigations were performed in the frequency range from 20-80 c.p.s. to 10-20 kc.p.s. Finally it was found out that the frequency response in the mentioned frequency range was generally determined by one collection time, caused by ion drift velocity. A consequence of this is the fact that the frequency responses for almost all the examined detectors are satisfactorily being described by the expression $a + b/\omega^2 + \Xi^2$, where a and b are constants, Ξ is break frequency. The value of Ξ is linearly dependent on the detector applied voltage in a wide range of voltage and pressure change.
Author (ESRO)

N69-14960# Compagnie des Compteurs, Montrouge (France).
ACTIVE STABILIZATION OF A GONDOLA FOR STRATOSPHERIC BALLOONS [STABILISATION ACTIVE D'UNE NACELLE POUR BALLONS STRATOSPHERIQUES]
Paul Bizouard, Jean Arbes, Pascal Godin, and Jean-Claude Rasult 1968 7 p In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

An active stabilization device for an instrument package suspended from a stratospheric balloon has been developed. Different ways of stabilization like Oy-motor, inertia block displacement, inertia wheel gas jet, action of geomagnetic field on dipoles are analyzed. The choice of a combined solution for the specific problems envisaged is justified and its performance discussed.
ESRO

N69-14961# Compagnie des Compteurs, Montrouge (France).
ATTITUDE RECONSTITUTION OF A SOUNDING ROCKET NOSE CONE BY STAR SENSOR [RECONSTITUTION D'ATTITUDE D'UNE POINTE DE FUSEE SONDE PAR SENSEUR STELLAIRE]
Guy Soite and Pascal Godin 1968 9 p In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

The technology of an airborne optical star-tracker is described as well as measurements that will give the time bearing of the instrument. Working conditions and accuracy of the measurements are discussed.
ESRO

N69-14985# Technical Operations Research, Burlington, Mass.
FEASIBILITY STUDY FOR AIRBORNE ICE-CRYSTAL DISDROMETER Final Report, 15 Feb. 1967–14 Aug. 1968
John H. Ward and William A. Dyes 13 Sep. 1968 19 p refs
(Contract F19628-67-C-0140)
(AD-676991; TO-B-68-55) Avail: CFSTI CSCL 14/5

A prototype ice-crystal hologram camera was fabricated and tested. The instrument will record ice crystals and raindrops in the 0.1 mm to centimeter size range over a sample volume 50 cm deep. An off-axis coherent reference beam is produced in the camera by use of a grating and pinhole spatial filter. Motion of the particles is stopped by a Q-switched ruby laser. This design is adaptable to airborne applications. Author (TAB)

N69-14989# General Electric Co., Schenectady, N. Y. Research and Development Center.
COLOR RATIO PYROMETER SYSTEM Final Report, Oct. 1967–Feb. 1968
Marshall D. Ketchum Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. Sep. 1968 43 p
(Contract F33615-68-C-1130)
(AD-677194; S-68-1075; AFAPL-TR-68-109) Avail: CFSTI CSCL 14/2

Theoretical and experimental data are presented that establish the feasibility of designing a Color Ratio Pyrometer to be used with a jet engine stator blade test facility for making remote measurement of blade surface temperature. The pyrometer was designed and constructed to be usable over a temperature range of 1500F to 2000F with an accuracy of plus or minus 25F. The optical system is located 24 inches from the stator blade. A scanning system allows measurement of any preselected, 0.125-inch-diameter spot within a 4-inch-diameter field of view in the plane of the stator blades. Author (TAB)

N69-14990# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ATTITUDE RECONSTITUTION OF A SOUNDING ROCKET NOSE CONE BY STAR SENSOR [RECONSTITUTION D'ATTITUDE D'UNE POINTE DE FUSEE-SONDE PAR SENSEUR STELLAIRE]
Philippe Ricklin 1968 14 p ref In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

An attitude reconstitution system based on a stellar sensor associated with a gyroscope has been developed by ONERA for the first time in the experiment TACITE. The operating mode of this system is described and the calculation of the elements explained. Accuracy and sensitivity of the measurements are discussed. ESRO

N69-15004# Burndy Corp., Norwalk, Conn. Research Div.
THE MICROTOPOGRAPHY OF SURFACES
J. B. P. Williamson and R. T. Hunt 26 Jan. 1968 28 p refs Presented at Oxford Conf. on the Metrology of Surfaces, Apr. 1968
(RR-59) Avail: Issuing Activity

This paper describes an approach to the study of surfaces based on the digital analysis of data obtained from profilometric examinations. This technique is used to determine several new surface texture parameters, including the surface density, height distribution, and mean radius of curvature of the asperities. The study also shows that many surfaces have height distributions which are Gaussian, and in particular that the heights of the upper half of most surfaces closely follow a Gaussian distribution. By combining data obtained from many closely spaced parallel profiles it has been possible to reconstruct detailed maps of the surface texture. Two examples are discussed: bead blasted aluminum, and a glass surface lightly blasted with alumina. One of the advantages of microcartography is that it permits the geometry of the contact between rough surfaces to be studied in detail. A map is given showing the way in which the contact area between two bead blasted aluminum surfaces splits into sub-areas and how these sub-areas are distributed with respect to the surface features of the contacting solids. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N69-14082*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYTICAL METHOD FOR PREDICTING THE PERFORMANCE OF CENTRIFUGAL PUMPS DURING PRESSURIZED STARTUP
Wojciech Rostafinski Washington Jan. 1969 40 p refs
(NASA-TN-D-4967) Avail: CFSTI CSCL 13K

The pressure drop characteristics of centrifugal pumps during pressurized startup were studied analytically. Mathematical expressions for negative head characteristics were developed and applied to the prediction of pressure drop characteristics for three pumps. Comparison of calculated and experimental performance points verified the analytical method developed. Author

N69-14128# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF CONCENTRATION OF WATER AND COMPOSITION OF FATTY ACIDS ON STRUCTURE AND PROPERTIES OF SYNTHETIC LUBRICANT GREASES
Yu. L. Ishchuk et al 5 Dec. 1967 16 p refs Transl. into ENGLISH from the book "Neftepererabotka i Neftekhimiya" 1965 p 67–76
(AD-677253; FTD-HT-23-1208-67) Avail: CFSTI CSCL 11/8

A series of greases were prepared from the residue of the synthesis of synthetic fatty acids (acid number 103 mg KOH/g), C5-C9 acids (290 mg KOH/g), and acid water (248 mg KOH/g); the dispersion medium was a mixture of Z spindle oil and S machine oil. This composition corresponds to that of commercial synthetic grease. It was found that a change in the water content of the greases in the range of 1 to 5% does not affect their volume mechanical properties or structure, indicating that it is desirable to raise the water content of such greases to 4-5%. The structure of hydrated calcium lubricants prepared from soaps of narrow fractions of heat-treated and distilled synthetic fatty acids and their mixtures differs from the structure of fatty and synthetic greases in that it consists of rod-shaped, petal-shaped, and flaky soap crystallites. The greatest thickening capacity is displayed by C16-C20 acids with an average molecular weight of 286-300 and a purity of the fraction of no less than 90-95%. A wide boiling fraction of C13-C22 acids with a purity of no less than 98% is recommended for practical application and for producing high-quality synthetic grease. Author (TAB)

N69-14154# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
MATERIALS JOINING TOOL Final Report, May 1967–Apr. 1968
Marvin L. Kohn Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. Sep. 1968 67 p refs
(Contract F33615-67-C-1424)
(AD-677303; AFAPL-TR-68-60) Avail: CFSTI CSCL 22/2

The use of nonthermionic cathodes was investigated as a heat-energy source for welding in space. This program included the design, manufacture, and performance of welding tests on two tools. One tool, using an annular cathode, was designed to weld tubing up to 3/8-inch outside diameter and wires and rods as large as 1/8-inch diameter. The second tool, with a linear cathode, was designed to produce linear welds of variable length. The tools were built and tested. Author (TAB)

N69-14191# Columbia Univ., New York. Lubrication Research Lab.

A THEORETICAL AND EXPERIMENTAL STUDY OF THE DYNAMIC BEHAVIOR OF FOIL BEARINGS

T. Barnum and H. G. Elrod, Jr. Oct. 1968 190 p refs

(Contract Nonr-4259(14))

(AD-677326; TR-144) Avail: CFSTI CSCL 13/9

The report develops a linearized theory for an infinitely wide, perfectly flexible foil bearing subjected to small fluctuations in tape tension. The theory neglects foil mass, but includes fluid compressibility. An experiment has been performed which verifies the theory in the ranges of speed and tension for which compressibility is negligible, but which are also the usual ranges for tape drive applications. Author (TAB)

N69-14207*# Automation Industries, Inc., Boulder, Colo.

DEVELOPMENT OF THE ULTRASONIC DELTA TECHNIQUE FOR ALUMINUM WELDS AND MATERIALS Final Report

K. J. Hannah, B. T. Cross, and W. M. Tooley 15 May 1968 76 p refs Previously announced as N68-34770

(Contract NAS8-18009)

(NASA-CR-61952; Rept-68-25) Avail: CFSTI CSCL 13H

The Delta Technique is a unique, multi-crystal inspection method that is relatively insensitive to defect orientation. Internal weld defects including lack of penetration and lack of fusion were readily detected using this technique. This technique is capable of rapid scanning rates while providing a simultaneous and permanent record of the test results. Test demonstrated that the Delta Technique successfully detected the weld defect of primary concern in 2014 and 2219 aluminum alloy weldments at inspection rates of 50 ft/hr. Lack of penetration of a 0.030" × 0.060" size and lack of fusion as narrow as 0.025" were reliably detected by the Delta Technique. Microfissuring, a laminar shrinkage type defect found in 3/16" and 1/4" weld sections was detected by the Delta Technique where radiographic techniques failed because of unfavorable defect orientation. Correlation of the nondestructive tests was made by destructively analyzing 18 feet of weld for total defect content. Results show that for a quantity of weldments containing tight lack of penetration up to 80% of the total defects were detected by the Delta Technique while only 36% of the total defects were detected with radiography. A manual Delta probe and a Delta wheel assembly were fabricated, and an evaluation of these configurations was made. Both the Delta wheel and the manual Delta probe provided the same quality of weld inspection obtained in previous studies. Author

N69-14214*# Ampex Corp., Redwood City, Calif.

STUDY, FABRICATION AND TESTING OF A FOIL-BEARING ROTOR SUPPORT SYSTEM

L. Licht and A. Eshel Washington NASA Nov. 1968 233 p refs

(Contract NASw-1456)

(NASA-CR-1157; RR-68-2) Avail: CFSTI CSCL 13I

Tests are conducted in both the vertical and horizontal attitudes, in excess of rated speed, 60,000 rpm, with the foil bearing stable and free from "half-frequency whirl" encountered in conventional gas-lubricated journal bearings. External pressurization is applied briefly to separate the foil surfaces from the journal during the initial and final stages of rotation only, with adequate self-acting support and foil separation established at approximately 6000 rpm. The response of the foil-rotor system to residual unbalance and to impact is studied. The foil-rotor assembly housing is mounted on a vibrator and subjected to excitation normal to the axis of rotation. Measured gap widths and results predicted by theory are compared, and an attempt is made to account for the effects of inertia and compressibility of the fluid, of extensibility and temperature increase of the foil, and of friction of the foil supports. The potential and practicality of gas-lubricated foil bearings for high-speed turbomachines is demonstrated, with the following advantages: (1) Stability (freedom from "half-frequency whirl); (2) Tolerance of distortion and misalignment, coupled with excellent wipe-wear characteristics; and (3) Ability to accommodate excursions of journals exceeding by an order of magnitude the clearance of rigid-surface gas bearings. Author

N69-14241*# National Aeronautics and Space Administration, Washington, D. C.

JOINING CERAMICS AND GRAPHITE TO OTHER MATERIALS

H. E. Pattee, R. M. Evans, and R. E. Monroe 1968 89 p refs

(NASA-SP-5052) Avail: SOD $1.00 CSCL 13H

In discussing the joining of bulk ceramics to metals and other materials, this report emphasized ceramic-to-metal joining as applied in the electronics industry. However, the techniques developed for joining ceramics to the metals of interest to the electronics industry can usually be applied to other materials as well. Data are summarized on joining ceramics to other materials available from Government and industrial research. Much of the research was prompted by a need to develop joining or sealing techniques for specific applications which are related throughout the report in hope that the information can be applied to applications that are similar or involve unusual materials or service conditions. The sections include: a review of ceramics, metals, and brazing filler metals; joint configurations and surface preparation; the theory of ceramic-to-metal joining; fusion, solid phase, gas-pressure, and solid liquid phase joining; and fusion and nonfusion joining of graphite. B.P.

N69-14383*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ROLLING-ELEMENT FATIGUE LIFE OF AUSFORMED M-50 STEEL BALLS

Richard J. Parker and Erwin V. Zaretsky Washington Dec. 1968 17 p refs

(NASA-TN-D-4954) Avail: CFSTI CSCL 13I

Rolling element fatigue lives of a group of ausformed consumable electrode vacuum melted steel balls were compared with two groups of conventionally processed balls in the NASA five-ball fatigue tester. Results indicate an improvement in fatigue life with the ausformed balls at least three times that of the conventionally processed balls. Author

N69-14456 Wisconsin Univ., Madison.

ANALYSIS SYSTEMS FOR MACHINE TOOL STRUCTURAL DESIGN

Bruce Craig Cuppan (Ph.D. Thesis) 1967 320 p

Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 67-16920

Analytical methods of determining static and dynamic machine tool characteristics by digital and analog computer programming are presented. Application of the methods has been verified through experimentation. A form of the Myklestad method is developed and applied in the calculation of natural frequencies and mode shapes of a typical die mill machine. This analysis results in dynamic design curves which make it possible for the designer to consider the dynamics when designing the machine structure. A stiffness matrix method, considering six degrees of freedom, is developed and applied to the static and dynamic analysis of four model structures.

Computer programs used here and in the Myklestad method are listed and described in detail. A modal method of structural transfer function representation is developed and used in an analog computer simulation of an entire machine system. Various studies made with this simulation are discussed and other possible studies indicated. Dissert. Abstr.

N69-14462# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE EFFECT OF VARIOUS TECHNOLOGICAL FACTORS AND TEMPERATURE ON THE ANTIFRICTION PROPERTIES OF SOLID LUBRICANT COATINGS BASED ON MOLYBDENUM DISULFIDE

R. M. Matveyevskiy et al 6 Dec. 1967 10 p refs Transl. into ENGLISH from Mashinoved. (USSR) no. 2, 1968 p 86–90
(AD-677688; FTD-HT-23-1063-67) Avail: CFSTI CSCL 11/8

A report is given on tests of a solid lubricant based on molybdenum disulfide with a binder of ureaformaldehyde resin. Author (TAB)

N69-14475# Systems Research Labs., Inc., San Antonio, Tex.

AIR-BEARING SYSTEMS FOR GROSSLY MISMATCHED SURFACES

W. E. Rothe Brooks AFB, Tex. School of Aerospace Med. May 1968 20 p refs
(Contracts AF 41(609)-3104; F41609-67-C-0079)
(AD-677592; SAM-TR-68-83) Avail: CFSTI CSCL 14/2

The purpose of this program was to construct a new air-bearing system for the All-Attitude Air-Bearing Research and Training Simulator to improve the control characteristics of the vehicle, reduce the noise level, eliminate the need for the supplemental jet starter, and facilitate higher rotational rates. Three identical self-aligning air-bearing pads were constructed and mounted on three individual support pedestals. The support pedestals were attached 120 degrees apart around the existing support base, which was reinforced. The air-bearing pads contacted the sphere in the lower third of the configuration. The improved air-bearing system brought the noise level into an acceptable range, reduced the air-supply demands by a factor of 3, and eliminated the need for the supplemental jet starter. The problems encountered in the air-bearing suspension of two excessively mismatched surfaces were successfully resolved. The 3-point self-aligning principle was utilized. Modifications were made in a conventional small-orifice, static air bearing with features of a step and an all surface supply air-bearing system. Author (TAB)

N69-14512*# General Electric Co., Schenectady, N. Y. Mechanical Equipment Branch.

DESIGN CRITERIA FOR ZERO LEAKAGE CONNECTORS FOR LAUNCH VEHICLES. TUBE CONNECTOR WITH SUPERFINISHED SEAL, VOLUME 4 Final Report

B. Weichbrodt Jan. 1968 110 p refs
(Contract NAS8-4012)
(NASA-CR-94157; S-68-1015-Vol-4) Avail: CFSTI CSCL 13K

The development of a new type of tube connector which is reusable and seals without a gasket is described. Instead of a gasket it uses a superfinished surface seal, and is designed for 6000 psi service at temperatures ranging from −320° to 700°F. Extensive tests were conducted and show that leakage is less than 3×10^{-6} atm-cc/sec for helium. Typical requirements on the surfaces are flatness with 10 microinches over the entire seal area and the absence of any scratches or other local defects with a depth larger than 1/2 microinch. Numerous design drawings and calculated stresses are included. C.T.C.

N69-14513*# General Electric Co., Schenectady, N. Y. Mechanical Equipment Branch.

DESIGN CRITERIA FOR ZERO LEAKAGE CONNECTORS FOR LAUNCH VEHICLES. ADVANCED LEAKAGE TESTS, VOLUME 3 Final Report

J. P. Laniewski 20 Jul. 1967 82 p refs
(Contract NAS8-4012)
(NASA-CR-94160; S-68-1015-Vol-3) Avail: CFSTI CSCL 13K

Sealing investigations were conducted in the temperature range of −321° to 400°F and at pressure differentials to 6000 psi. The following determinations were made: (1) the amount of gasket stress required to affect a seal, (2) the gasket stress required to maintain a seal, (3) when rubber or plastic seals should be used instead of metal seals, (4) the effect temperature variation has on the seal, (5) the effect of surface finish on leakage, and (6) the effect of various material combinations. The sealing devices investigated were metal gaskets, plastic gaskets, rubber gaskets, and direct metal-to-metal seals. Ten tests were conducted with metallic gaskets using copper, aluminum, and nickel materials between aluminum and stainless steel surfaces. The aluminum and stainless steel surfaces in these tests were of three different finishes: coarse circumferentially machined, fine circumferentially machined, and radially ground. Discussions of the test methods, and specific conclusions and recommendations are included. C.T.C.

N69-14514*# General Electric Co., Schenectady, N. Y. Management Equipment Branch.

DESIGN CRITERIA FOR ZERO LEAKAGE CONNECTORS FOR LAUNCH VEHICLES. MATHEMATICAL MODEL OF INTERFACE SEALING PHENOMENON, VOLUME 2 Final Report

L. G. Gitzendanner, J. K. Hawley, H. W. Moore, F. O. Rathbun, Jr., and J. Wallach 9 Nov. 1967 124 p refs
(Contract NAS8-4012)
(NASA-CR-94159; S-68-1015-Vol-2) Avail: CFSTI CSCL 13A

A procedure for the calculation of leakage flow through the seal interface of a fluid connector was developed and evaluated. This is the initial step in an ultimate development of a sufficiently accurate and economical calculation procedure that will qualify as a design tool. Perfectly flat, randomly lapped identical surfaces were manufactured for the experimental evaluation of the calculation procedure. The leakage flow of helium was experimentally measured and calculated. The following procedures were followed in the calculation: (1) surface roughness measurements were made, (2) surface statistics were calculated, (3) the surfaces were generated mathematically and pressed together mathematically, (4) the interfacial gap map was generated, (5) a flow map was generated, (6) flow parameters were calculated, and (7) the flow was calculated. Of these steps, all but the flow map generation are programmed for digital computers. Author

N69-14515*# General Electric Co., Schenectady, N. Y. Mechanical Technology Lab.

DESIGN CRITERIA FOR ZERO LEAKAGE CONNECTORS FOR LAUNCH VEHICLES. COMPUTER PROGRAMS FOR FLANGED AND THREADED CONNECTOR DESIGN, VOLUME 1 Final Report

R. E. Smith, E. J. Leclerc, and M. C. Ray 5 Oct. 1967 259 p refs
(Contract NAS8-4012)
(NASA-CR-94158; S-68-1015-Vol-1) Avail: CFSTI CSCL 13E

A computer program is described which will produce a connector design when given functional requirements such as operating pressures and temperatures, and material properties such as Young's modulus and allowable stress. The analyses and procedures in the program are based upon calculating static stresses in an assembled connector due to internal pressure, axial pipe load, pipe bending moment, and differing coefficients of thermal expansion between components. The program may also be used to perform a stress analysis on an existing design with the addition of the parameters of the particular configuration to be analyzed. C.T.C.

N69-14558# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WEAR CHARACTERISTICS OF METAL-POLYMER FRICTION PAIRS
V. G. Kravchenko et al 4 Dec. 1967 8 p Transl. into ENGLISH from Tekhnol. i Organ. Proizv., no. 1, 1966 p 23–25
(AD-677690; FTD-HT-23-1143-67) Avail: CFSTI CSCL 11/8

The authors study the wear of metal-polymer friction pairs. The shank of a blade working in a variable-pitch propeller encasement was studied as a friction pair, a textolite bushing was used as one member of the pair and the propeller shaft, made of steel, was used as the other. Author (TAB)

N69-14721# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOELECTRIC CONTROL SYSTEMS FOR LINEAR MAGNITUDES
L. N. Vorontsov 29 Dec. 1967 234 p refs Transl. into ENGLISH of the book "Fotoelektricheskiye Sistemy Kontrolya Lineynykh Velichin" Moscow, Izd. Mashinostr., 1965 p 1–236
(AD-677246; FTD-MT-24-256-67) Avail: CFSTI CSCL 13/8

The book is intended for technicians in scientific research institutes and factories concerned with the development and operation of automatic control systems. It could also be useful to students in courses on machine building and instrument making in schools of higher education. The principles of designing control devices for linear and angular dimensions as well as devices controlling surface roughness and defects are reviewed. Photoelectric devices, their pickups and basic components are described. Special attention is paid to the use of photoelectric devices in conjunction with transmitting and receiving cathode-ray tubes. TAB

N69-14737*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
VIBRATION/VACUUM SCREENING OF SPACE LUBRICANTS Final Report
Francis J. Clauss and Sanford P. Drake, Jr. 31 Dec. 1967 96 p
(Contract NAS8-5114)
(NASA-CR-92435; LMSC-684903) Avail: CFSTI CSCL 11H

Selected solid-film lubricants and self lubricating retainer materials were evaluated for use on small ball bearings operating in a simulated space environment. Test conditions include a combination of vacuum (10^{-7} torr), low and moderately elevated temperatures (−200°F to +200°F) and severe vibration (26g rms, 85g peak). The effects of operating in such environments on the subsequent lifetime in vacuum has been experimentally measured. Results are compared with those for a selected oil and grease. Author

N69-15001# Eidgenossische Technische Hochschule, Zurich (Switzerland).
AN INVESTIGATION OF THE INFLUENCE OF RING SPINNING VARIABLES ON THE TRAVELLER FRICTION
Mohamed Abd El-Aziz Eid (Ph.D. Thesis) 1968 139 p refs
/ts Dissertation No. 3949
Avail: CFSTI

All possible factors influencing the frictional characteristics of the spinning ring traveller system under normal running conditions were investigated, and empirical formulas were obtained for predicting the coefficient of friction. To assess the friction conditions between ring and traveller, a measuring technique was applied to determine directly the friction existing between the two elements. The equations were derived taking into account the spinning variables: ring diameter, traveller size, spindle speed, and yarn count. Most of the coefficients of friction determined were between 0.06 and 0.25, i.e., in the range of mixed friction, meaning that there existed some lubrication in the form of thin films of oil, metal oxides, or other materials. B.P.

N69-15011# Rocket Propulsion Establishment, Westcott (England).
DESIGN CRITERIA FOR A JOULE–THOMSON VALVE FOR A HYDROGEN LIQUEFIER
T. R. Horton Jun. 1967 24 p refs
(RPE-TM-442/UL) Avail: CFSTI

In small scale methods of liquefaction of hydrogen, the final process in the cycle is the expansion of gaseous hydrogen from about 130 atmospheres and 40°K through a Joule–Thomson needle valve, and up to the present time no rational basis for the dimensional design of this type of valve has been established. Two criteria are now shown to be necessary for its smooth and accurate operation: orifice diameter of the valve should be as small as is consistent with the required volumetric flowrate and with cool-down requirements, and the needle half-angle should be as small as is consistent with rigidity. To calculate the required flow area, the pressure, temperature, density and the local velocity of sound must be found for the Mach 1 condition at an entropy equal to that at the starting conditions, and it is shown that the Mach 1 condition cannot be reached before a liquid phase is present unless the temperature at the start of the expansion is above about 43°K. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N69-13955 California Univ., Berkeley.
VIBRATIONAL ENERGY TRANSFER IN MOLECULES EXCITED BY AN INFRARED LASER
James Thomas Yardley, III (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-5850

A new technique for the study of vibrational energy transfer as a result of intermolecular collisions is described. The experiments involve the use of an infrared laser to produce vibrationally-excited molecules. Infrared fluorescence from the molecules is used to monitor the populations of different energy states as a function of time. Energy transfer rates are determined by measuring the phase lag of the fluorescence as a function of the frequency at which the laser beam is modulated. All of the experiments are done at 24° ± 2°C. Experimental results are reported for methane which is excited to the asymmetric stretching (ν_3) vibrational level by a He–Ne gas laser. Fluorescence has been observed from the asymmetric stretch (near 3000 cm^{-1}) and from the bending vibration (ν_4, near 1306 cm^{-1}). Dissert. Abstr.

N69-14065*# Honeywell, Inc., St. Paul, Minn. Research Dept.
CARBON DIOXIDE LASER Progress Report, 1 Jul.–15 Sept. 1967
Hans W. Mocker 1 Oct. 1967 17 p refs
(Contract NAS8-20645)
(NASA-CR-98219; Honeywell-12044-PR4) Avail: CFSTI CSCL 20E

The shift of the frequency of oscillation of the 00°1 to 10°0 rotation–vibration band at 10.6 μ of a CO_2 laser was investigated as a function of total pressure, CO_2-partial pressure, discharge current, and cavity mode position. The measurements were made by heterodyning two passively stabilized CO_2 lasers, both oscillating in a single transverse mode and single frequency at the P-branch of the 00°1 to 10°0 rotation–vibration band of CO_2. The result yielded a 5 to 8 MHz/torr frequency shift towards red due to an increase in total pressure and a 500 to 900 kHz/mA shift toward blue due to an increase in excitation. The amount of frequency shift due to excitation was found to be independent of

the location of the cavity resonance with respect to the Doppler center. The dependence on CO_2 partial pressure was also determined. Author

N69-14268# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ESTIMATING THE SPECTRAL WIDTH OF EMISSION OF SOLID-STATE LASERS OPERATING UNDER NONSTATIONARY CONDITIONS
A. M. Samson 14 Dec. 1967 10 p refs Transl. into ENGLISH from Dokl. Adad. Nauk Belorusak. SSR (Minsk), v. 10, no. 8, 1966 p 553–557
(AD-677131; FTD-HT-23-1074-67) Avail: CFSTI CSCL 20/5

Under nonstationary conditions many types of oscillation (modes) are simultaneously generated unless measures are taken to select them. In lasers with plane-parallel mirrors every generating mode can be described with adequate accuracy by a plane wave of a certain frequency and direction. Consequently the coexistence of many modes unavoidably increases angular and spectral width of emission. TAB

N69-14301# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MORE POWERFUL THAN THE HYPERBOLOID
O. Andreyev 6 Dec. 1967 9 p Transl. into ENGLISH from Voyennyye Znaniya (USSR), v. 41, no. 2, 1965 p 38–39
(AD-677221; FTD-HT-23-1096-67) Avail: CFSTI CSCL 20/5

Many pre-World War II Soviet publications carried articles on the so-called death rays. More often than not, these articles, based largely on non-Soviet data, were pure science fiction. The few serious articles referred to deadly weapons using heat rays. The concept of weaponry changed drastically with the advent of lasers, which emit stimulated rather than thermal radiation. Mention is made of the use of lasers in multichannel communication systems, ranging of planetary surfaces, metallurgy, plasma diagnostics, biology, medicine, etc. The article also reviews Soviet contributions to the development of the laser. TAB

N69-14461* Hewlett-Packard Co., Beverly, Mass. Frequency and Time Div.-East.
HYDROGEN MASER FOR FIELD USE Technical Report, Jun. 27, 1966–Jan. 30, 1968
R. Vessot and L. Mueller 26 Feb. 1968 62 p
(Contract NAS8-2604)
(NASA-CR-98220) Avail: CFSTI CSCL 20E

Structural design and electronic components of a complete maser for field use are presented. The maser incorporates the cavity and bulb design of a maser being developed for satellite applications and includes the latest developments in structure and electronics to provide as rugged and reliable an instrument as possible. Solid state circuitry is used throughout, and no moving parts, such as fans or blowers, are included. Shielding techniques are used to minimize stray r.f. radiation. Author

N69-14467# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RAMAN MASERS
Tieh-Ch'eng Li and Yu-P'ing Huo 18 Sep. 1967 35 p refs Trans. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 12, 1965 p 1933–1950
(AD-677071; FTD-HT-67-388) Avail: CFSTI CSCL 20/5

The equations describing the stimulated Raman process, namely, the coupling equations of the laser light, the first Stokes light, the anti-Stokes light and the coherent phonon field are derived from the hamiltonians with the relaxation and dissipation terms phenomenologically introduced. The properties of the equations are analyzed by an approximation higher than the quasistatic approximation under the condition that the molecules are far from resonance. The threshold for the Raman maser is obtained from the discussion of the stability of equilibrium point. It is found that the production of anti-Stokes light requires no additional threshold condition, that is, the anti-Stokes light is a natural consequence of the stimulated Raman effect. The operation and the characteristics of various quiescent points of the Raman maser are also discussed. It is found that under certain conditions, there is only one stable equilibrium point (the quiescent point of the Raman maser) at which the Stokes and anti-Stokes components appear with equal intensity when the Raman-active medium is pumped by an intensive laser beam. Also discussed in the paper are the effect of phonon relaxation and the behavior of a Raman maser with phonons of long lifetimes. Author (TAB)

N69-14550 Wisconsin Univ., Madison.
WAVELENGTH STABILITY OF GaAs DIODE LASERS
Robert James Proebsting (Ph.D. Thesis) 1967 183 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-16998

The object of the research reported in this thesis has been to examine the properties, particularly the spectral properties, of GaAs diode lasers. Electrical and optical measurements were performed on hundreds of diode lasers. Threshold current was found to increase exponentially with temperature below about 100°K and as $T^{5/2}$ from about 50°K to at least 170°K. The emission wavelength at threshold was observed to increase as the square of the absolute temperature, but at a rate approximately 50 percent greater than that predicted from intrinsic band gap data. The dynamics of the spectral shift of pulsed lasers at 77°K were studied in detail. The spectral shift was calculated for a thermal model that assumes the junction power dissipation occurs in an infinitesimally thin plane at the p–n junction of a thermally insulated laser. This model predicts a square root of time dependence during the first microsecond of a pulse and a linear dependence thereafter. Dissert. Abstr.

N69-14567# Southwest Research Inst., San Antonio, Tex.
PERFORATION OF PLASTIC FILMS WITH CARBON DIOXIDE LASER RADIATION Final Report
H. S. Silvus, Jr. and Robert L. Bond May 1968 53 p
(Contract DAAA21-68-C-0692)
(AD-677121) Avail: CFSTI CSCL 13/8

Perforation of the plastic film which forms the walls of a salt pellet sub-pack was accomplished using the focused beam from a carbon dioxide laser operating at 10.6 microns wavelength in the TEMoo mode. Typical hole sizes were 8 to 12 mils in diameter with two holes punched simultaneously, one in each of two layers of plastic film separated by approximately 0.2 inch. The holes thus obtained were clear of obstructions and had smooth, rounded edges. Polyethylene was found to yield the best results. A double exposure of the packet to the radiation produced the most reliable and consistent operation. Typical values of exposure were 100 milliseconds and 67 milliseconds respectively at a power level of 1.4 to 1.8 watts. A short production run was executed to provide a quantity of perforated salt pellet sub-packs for statistical evaluation. In addition, design details of a production line machine to perforate packets at a nominal rate of one packet per second were developed. A brief study to determine the feasibility of sealing and cutting polyethylene film using carbon dioxide laser radiation was accomplished. The results of this study indicate that sealing and cutting are feasible. Author (TAB)

N69-14571# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN LASER ABSTRACTS, VOLUME 1, NUMBER 1, 1968
Oct. 1968 55 p
(AD-677073; ATD-69-14-14-4-VOL-1-NO-1) Avail: Issuing Activity CSCL 20/5

This is a new monthly publication intended to bring together the current laser research and development papers published in the open-source scientific and technical literature of the Soviet Bloc countries. All materials directly pertinent to the laser field will be included for presentation under the following subject headings: Gas; Molecular beam; Glass; Paramagnetic crystals; Semiconductors; Liquid and organic media; Emission characteristics--generation dynamics; Spectroscopy of laser materials; Components; Nonlinear optics; Interaction of light energy with matter; Interaction of laser beam with the atmosphere; Applications; Organizational events; and Miscellaneous. Author (TAB)

N69-14893# Florence Univ. (Italy).
LASER CAVITIES. PART 1: RESEARCH ON OPEN RESONATORS Final Report, 1 Apr. 1965–15 Apr. 1968
P. F. Checcaci, A. Consortini, and A. M. Scheggi 15 May 1968 73 p refs
(Contract AF 61(052)-871)
(AD-677721; AFCRL-68-0532) Avail: CFSTI CSCL 20/5

The present report is concerned with both theoretical and experimental research performed in the last three years on open resonators. In the first part two different theoretical approaches are extensively reported on the problem of modes and loss of a new type of open resonator terminated by flat roof mirrors. The experimental investigation described in the second part consisted in studying the performance and characteristics of open resonators by means of microwave models. Experimental tests have been performed on X-band models of planar F.P. resonators, of resonators terminated by roof mirrors (flat-roof, 90 deg. roof) and of rimmed mirror resonators. Author (TAB)

N69-14709# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MASERS
A. N. Orayevskiy 15 Nov. 1967 245 p refs Transl. into ENGLISH of the book "Molekulyarnye Generatory" Moscow, Izd. Nauka, 1964 p 1–294
(AD-677023; FTD-MT-24-110-67) Avail: CFSTI CSCL 20/5

In this monograph the physical principles of molecular generation and of the amplification of electromagnetic waves, constructional features, theory and characteristics of masers are presented. Special attention is paid to the stability of the oscillation frequencies of masers, which is associated with the basic aspects of their use. The book is designed for engineers, scientific workers, aspirants, and advanced students specializing in the field of quantum radiophysics. TAB

N69-14790# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
DETECTION OF ATMOSPHERIC OXYGEN USING A TUNED RUBY LASER
James B. Mason Jun. 1968 37 p refs
(AD-677389; ECOM-5199) Avail: CFSTI CSCL 4/1

A Q-switched ruby laser has been provided with a tuning capability by employing a cryogenic temperature control. Atmospheric transmission of the laser output over a 9.8 km path was measured while the laser was tuned in the wavelength region of the O2 absorption line at 6941.22A. Absorption of the laser output at this wavelength is clearly indicated by the data. Resolution of the system and factors affecting it are discussed, and possible refinements are considered with a view toward atmospheric probing. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N69-13924 Rutgers Univ., New Brunswick, N. J.
A SINTERING STUDY OF HIGH PURITY BARIUM TITANATE
Howard Wichansky (Ph.D. Thesis) 1967 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-4560

Three sources of ultrapure barium titanate were processed to maintain purity and fired to temperatures that ranged from 1275 to 1525°C in vacuum, air, and oxygen atomospheres. It was found necessary to define the characteristics of the raw powder and clearly identify the microstructure as it developed with heat treatment. Although all three materials were classified as ultrapure, distinctions in particle size, particle shape, and agglomerating tendency were established from electron photomicrographs. Differences in purity were identified by chemical analysis, but all materials were very nearly stoichiometric. Fabricating parameters—forming pressure, water content, and calcination of prereaction—were examined for each source relative to maximizing fired density. Firing the several barium titanates yielded various levels of densification which were a consequence of the properties of the starting powders. A long firing range was noted for all materials, but grain growth was considerable. Dissert. Abstr.

N69-13943# Bhabha Atomic Research Centre, Bombay (India).
STUDIES ON SINTERING OF BERYLLIA. PART 4: MECHANISM OF SINTERING DURING HOT PRESSURE OF BERYLLIA
V. K. Moorthy and R. Bhat 1967 22 p refs
(BARC-323-Pt-4) Avail: CFSTI

The beryllium oxide obtained by calcination of $Be(OH)_2$ at various temperatures was hot pressed at different temperatures and pressures. The densities obtained depended on the calcination temperature and increased directly with an increase in either the hot pressing temperature or pressure. The data is found to be in accord with McClelland's equation; both the yield stress and activation energy are found to be enhanced with an increase in calcination temperature. It thus appears that the densification during hot pressing of active BeO powders is due to macroscopic material movement (plastic flow) and is directly dependent on the crystallinity of the powder. Author

N69-13988 California Univ., Berkeley.
CREEP MECHANISMS IN Fe-4 PERCENT Si ALLOY
Anwar-ul Karim (Ph.D. Thesis) 1967 50 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-5744

Studies were conducted over the temperature range of 625 to 1175 deg. K in order to reveal the effect of the Curie transformation and of short-range order on the creep mechanisms. Apparent activation energies for creep, determined by small abrupt changes in temperature, revealed that the activation energy increases with temperature, mildly and linearly up to 925 deg K and then very steeply reaching the maximum value at 1000 deg K, about the Curie point. Above the Curie temperature, however, the activation energy decreased sharply, reaching the minimum value at 1035 deg K, and then remained almost constant up to 1135 deg K, beyond which the apparent activation energy increased slightly with temperature. The stress law was determined by the effect of sudden changes in stress on the creep rate and revealed that, over both the ferromagnetic and the paramagnetic regions through the Curie transformation range, the creep rate varied as the fifth power of the shear stress. Equations were deduced for the nonconservative motion of jogged screw dislocations in a short-range ordered alloy and compared with the experimental results. The same mechanism governs the creep behavior both above and below the Curie transformation. Dissert. Abstr.

N69-14011*# Tyco Labs., Inc., Waltham, Mass.
STUDY OF THE GENERAL MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS AND DEVELOPMENT OF TECHNIQUES FOR ITS DETECTION Quarterly Report, 1 Dec. 1967–29 Feb. 1968

S. B. Brummer, R. O. Bell, F. H. Cocks, A. Cordellos, M. Krebs et al. 29 Feb. 1968. 98 p refs
(Contract NAS8-20297)
(NASA-CR-98184; QR-6) Avail: CFSTI CSCL 11F

The mechanism of the stress corrosion cracking of high strength aluminum alloys has been investigated using electrochemical, mechanical and electron microscopic techniques. Experiments have been carried out in 1M NaCl buffered to pH 4.7 at 30°C, using the commercial alloys 7075 and 2219 and relevant pure materials. The feasibility of detecting stress corrosion damage in fabricated aluminum alloy parts by nondestructive testing techniques has been investigated using ultrasonic surface waves (Rayleigh waves). Author

N69-14014 Lehigh Univ., Bethlehem, Pa.
STRUCTURE AND ELEVATED TEMPERATURE MECHANICAL BEHAVIOR OF UNIDIRECTIONALLY SOLIDIFIED NICKEL–NICKEL NIOBIUM EUTECTIC ALLOY
Robert Thomas Quinn (Ph.D. Thesis) 1967 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-4901

Mechanical behavior of the unidirectionally solidified eutectic Ni–Ni_3Nb was studied from ambient temperature to 1000°C. X ray diffraction and metallographic techniques were used to determine the crystallographic relationships between the two phases. The results of the mechanical tests of the controlled alloy compared to the "as-cast" alloy of the same composition prove the unidirectionally solidified Ni–Ni_3Nb eutectic alloy is strengthened in a direction parallel to the growth direction. A relationship is also shown between the softening temperatures of the intermetallic compound, the unidirectionally solidified Ni–Ni_3Nb, and the temperature at which the tensile strength of the controlled alloy begins to decrease significantly. Examination of fractured specimens shows the alloy fails after cracks are nucleated by cleavage of the Ni_3Nb phase. These cleavage failures in the intermetallic occur parallel to retained markings in a polished surface; they are probably manifestations of twinning. Dissert. Abstr.

N69-14039# Bhabha Atomic Research Centre, Bombay (India).
CORROSION STUDIES ON Al-9 PERCENT Si-1 PERCENT Ni ALLOY IN HIGH TEMPERATURE WATER
J. B. Gnanamoorthy and J. Balachandra 1968 8 p refs
(BARC-333) Avail: CFSTI

Since the inception of the nuclear energy programme, aluminum has been used as structural and cladding material in low temperature water-cooled nuclear reactors. However, for use in research reactors and in power reactors wherein the operating temperatures would be around 300°C, commercial aluminium alloys were found inadequate with respect to their corrosion, mechanical and nuclear properties. In the context of the extensive research work on the development of suitable aluminium alloys, ternary alloys containing a high percentage of silicon and a small amount of nickel have shown great promise in regard to their corrosion resistance properties. Investigations have confirmed the superior corrosion properties of the Al-7 to 13%Si–1%Ni alloys. However, no attempt has been made in these investigations to study the kinetics and mechanism of the corrosion processes of these alloys in high temperature water. The present work was undertaken with such an aim in view. An alloy of the nominal composition Al–9%Si–1%Ni was studied in the high purity water at 260°, 300° and 350°C. This paper reports the results of this investigation and discusses the tentative kinetics of this alloy. Author

N69-14076# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF FREON-22 ON CERTAIN ALUMINUM ALLOYS AND NONMETALLIC MATERIALS
G. B. Rozenboym et al. 7 Dec. 1967 10 p refs Transl. into ENGLISH from Sudostroyeniye, no. 7, 1966 p 51–54
(AD-677214; FTD-HT-23-1065-67) Avail: CFSTI CSCL 11/6

The corrosion behavior of wrought aluminum alloys AMg-3M, AMg-5VM, AMg-6, D-16AT and cast alloy 45 Mg-2 (4.8–6.5% magnesium) was tested in a circulating mixture of freon-22 and freon oil for 400 days. Author (TAB)

N69-14120# Aerojet-General Corp., San Ramon, Calif. Nuclear Div.
EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING. VOLUME 1: OXIDATION AND STRUCTURAL STABILITY INVESTIGATIONS Final Technical Report
W. L. Clarke, Jr. and G. W. Titus Jun. 1968 253 p refs
(Contract AT(04-3)-368)
(AGN-8289-Vol-1) Avail: CFSTI

The results are presented in sections on specimen preparation, aging procedures, evaluation techniques, structural stability studies, mechanical properties data, oxidation characteristics and analysis of data. NSA

N69-14136# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATE AND PROSPECTS OF DEVELOPMENT OF SHEET METAL STAMPING INDUSTRY [SOSTOYANIYE I PERSPEKTIVY RAZVITIYA LISTOSHTAMPOVOCHNOGO PROIZVODSTVA]
I. A. Noritsyn 21 Nov. 1967 12 p Transl. into ENGLISH from Vestn. Mashinostr. (Moscow) no. 4, 1967 p 6–10
(AD-677517; FTD-MT-24-307-67) Avail: CFSTI CSCL 11/6

This article describes the present state and prospects of development of the sheet-metal stamping industry in the U.S.S.R. Various aspects of sheet-metal stamping industry are discussed: explosive forming, pulsating electrohydraulic and electromagnetic stamping, etc. Author (TAB)

N69-14141# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIENCE IN PRODUCING COLD-PRESSED SEMIFINISHED ALUMINUM ALLOY PRODUCTS [OPYT POLUCHENIYA POLUFABRIKATOV IZ ALYUMINYEVYKH SPLAVOV KHOLODNYM PRESSOVANIYEM]
L. Kh. Raytbarg 18 Aug. 1967 5 p Transl. into ENGLISH from Tsvetn. Metal., no. 4, 1966 p 76–77
(AD-677069; FTD-HT-23-855-67) Avail: CFSTI CSCL 11/6

Cold pressing has the advantage that it dispenses with the need for the subsequent cold working of semifinished aluminum alloy products. In this connection, to determine the types of these products for which cold pressing is the most effective, rods, rectangular tubes and thin-walled irrigation pipe were experimentally cold-pressed in universal 800- and 1500-ton hydraulic presses with the aid of prestressed tools, on using high-molecular fatty alcohols as the lubricant. TAB

N69-14147# Bhabha Atomic Research Centre, Bombay (India).
THERMAL ACTIVATION IN ZIRCONIUM–CARBON ALLOYS
P. Das Gupta and V. S. Arunachalam 1968 18 p refs
(BARC-325) Avail: CFSTI

The effect of temperature and strain-rate on the yield and flow of zirconium containing about 1.4 at. % carbon has been examined at different temperatures between 77 and 700°K. The above measurements were coupled with strain-rate change tests so that all the deformation parameters associated with thermal activation could be evaluated. The results of these measurements showed that in pure iodide zirconium (principal impurity: 0.09 at. % O), the thermal component of flow stress and its activation energy are increased with the addition of carbon. This effect is strongly felt only during the first stage of thermal activation where impurities are rate-controlling. At higher temperatures, where the Peierls–Nabarro force is likely to be rate-controlling, the effect of

carbon is negligible. With impure zirconium containing large concentration of interstitials (≈1 at. % O), addition of carbon does not alter the activation parameters associated with the thermally activated deformation significantly. This is discussed on the basis of the potency of carbon as a hardener compared to oxygen.
Author (NSA)

N69-14184 Texas Univ., Austin.
INVESTIGATION OF INVAR TYPE ALLOYS FOR THE DESIGN OF FREQUENCY-TEMPERATURE INVARIANT VIBRATING SYSTEMS
Olin Eric Weiss (Ph.D. Thesis) 1967 221 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-4359

Invar type materials are used for their low thermal expansions and Elinvars are useful when only small thermal changes in the elastic modulus can be tolerated. When structures such as tuning forks are to be designed to vibrate at a frequency independent of temperature, both the thermal expansion and thermoelastic properties of the materials must be considered. Materials presently used for these applications are of the Elinvar type. These materials are difficult to process and have unstable characteristics of a magnetodiffusion nature. The material requirements for a structure to vibrate with a frequency independent of temperature are developed. For an isotropic and homogeneous material, the frequency will be temperature invariant when the linear thermal expansion coefficient is equal to the negative of the thermal coefficient of Young's modulus. Materials which approach these requirements have compositions near the Elinvar alloys and are defined here as Freinvars.
Dissert. Abstr.

N69-14193*# National Aeronautics and Space Administration, Washington, D. C.
THE METALLURGY, BEHAVIOR, AND APPLICATION OF THE 18-PERCENT NICKEL MARAGING STEELS A Survey
A. M. Hall and C. J. Slunder 1968 143 p refs Prepared by Battelle Mem. Inst., Columbus, Ohio
(NASA-SP-5051) Avail: SOD $1.50; CFSTI CSCL 11F

A comprehensive view is presented on the technical status of 18% nickel maraging steels and on the outlook for the future of these materials. Research and development efforts are reviewed in production, mechanical and physical properties, corrosion behavior, physical metallurgy, as well as in forming, joining, and heat treating. Patterns of usage, methods of producing a broad range of mill products, and other applications and uses are also discussed. The purpose of the survey was to provide the research worker, the materials engineer, the process engineer, the designer, and other interested persons information to assist in the selection of these steels for appropriate application and to serve as a point of departure for further study and evaluation of the maraging steels. The majority of the steels reviewed contained additions of cobalt, molybdenum, and titanium.
B.P.

N69-14194# Atomic Weapons Research Establishment, Aldermaston (England).
EXPERIMENTS TO IMPROVE THE MECHANICAL PROPERTIES OF WROUGHT URANIUM
P. D. Tilbury Jun. 1968 8 p refs
(AWRE-O-38/68) Avail: CFSTI

It is sometimes difficult in wrought and salt annealed alpha-uranium to achieve a room temperature elongation or more than 5%. Investigations were made into two possible methods of overcoming this difficulty, vacuum annealing to reduce hydrogen content, and warm working. The effect of nickel plating, which is used for corrosion resistance, upon the mechanical properties of vacuum annealed material was studied, as it was considered possible that the preparatory etching and plating process might re-introduce hydrogen.
Author (NSA)

N69-14200# Los Alamos Scientific Lab., N. Mex.
ESTIMATION OF OPTIMUM BINDER CONCENTRATION FOR MOLDED CARBONS
R. J. Imprescia 8 Aug. 1968 11 p refs
(Contract W-7405-eng-36)
(LA-3901) Avail: CFSTI

The optimum binder concentration of a given filler-binder system is usually determined by measuring properties of fabricated carbons as a function of binder content. This technique is necessarily lengthy and expensive. Two other methods are described for estimating the binder optimum, both of which are based on the determination of the void volume within the network of the compacted filler. The first of these makes use of a simple relation for calculating an apparent void volume from measurements on a hot-molded, pitch-bonded carbon. In the second method, a highly volatile lubricant is substituted for the binder in the mix and, by the weight loss on evaporation of the lubricant, an equivalent volume is calculated. The optima estimated by these two techniques agree well with those determined by the direct measurement of properties.
Author (NSA)

N69-14237# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METAL SCIENCE AND HEAT TREATMENT OF METALS
28 Sep. 1968 23 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 1, 1966 p 8–12, 63–66
(AD-677516; FTD-HT-67-276) Avail: CFSTI CSCL 11/6

CONTENTS:

1. INFLUENCE OF STRUCTURE ON THE PLASTICITY AND FRACTURE CHARACTER OF KhN70VMTYu AND EI826 ALLOYS Ye. M. Pivnik p 1–7 refs (See N69-14238 04-17)

2. DIFFUSION AND DIFFUSIONLESS TRANSFORMATIONS IN TITANIUM ALLOYS I. N. Bogachev et al p 8–17 refs (See N69-14239 04-17)

N69-14238# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF STRUCTURE ON THE PLASTICITY AND FRACTURE CHARACTER OF KhN70VMTYu AND EI826 ALLOYS
Ye. M. Pivnik *In its* Metal Sci. and Heat Treat. of Metals 28 Sep. 1967 p 1–7 refs (See N69-14237 04-17)
Avail: CFSTI

The alloys KhN70MVTYu (0.07% C, 15% Cr, 3.6% Mo, 5.5% W, 2.0% Ti, 2.0% Al, 0.005% B, 0.015% Ce) and EI826 (0.04% C, 14% Cr, 3.8% Mo, 6.1% W, 1.9% Ti, 2.7% Al, 0.012% B, 0.010% Ce) are used in industry as blade material. In the process of isothermal exposure (aging) at 700–850°C carbides form in addition to the basic hardening γ'-phase. In both alloys the carbides are located along the grain boundaries, but in the KhN70MVTYu alloy the carbides form in an almost continuous chain along grain boundaries, whereas in the EI826 alloy they are separated by comparatively large particles of γ'-phase. In the process of deformation foci of failure arise along the boundaries of carbides and γ-solid solution. The plastic properties of the alloys depend on the rate at which the isolated cracks forming in the process of deformation coalesce. In the KhN70VMTYu alloy at strain rates of 3.6 and 0.8%/hr the isolated cracks combined at a higher rate, which led to a marked decrease in plasticity. In the EI826 alloy a marked decrease in plasticity was produced only following straining at the rate of 3.6%/hr.
Author

N69-14239# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFUSION AND DIFFUSIONLESS TRANSFORMATIONS IN TITANIUM ALLOYS
I. N. Bogachev et al *In its* Metal Sci. and Heat Treat. of Metals 28 Sep. 1967 p 8–17 refs (See N69-14237 04-17)
Avail: CFSTI

In the paper by S. G. Fedotov and Ye. P. Sinodova, the treatment of martensitic transformation in titanium alloys contains, in our opinion, a number of statements that contradict theory and experimental data published in 1]–[8]. It seems to us that there is not adequate justification in this paper for the conclusion to the effect that there are different kinds of martensitic transformations in titanium alloys with β-isomorphic alloying elements (Mo, V) and in alloys with eutectoid-forming elements (Mo, Cr, Fe, Co, Ni). The paper cites experimental data on the variation of the elastic modulus of the hardened alloys as a function of the alloying-element content without data from phase analysis; hence the hypothesis advanced by the authors cannot be regarded as convincing. Analyzing the data of this paper, and those of [9]–[11], we may conclude that the smaller change in elastic modulus in martensite-hardened Ti–Mn, Ti–Cr, Ti–Fe, Ti–Ni, Ti–Co alloys, as compared with Ti–Mo, Ti–V alloys is due not to peculiarity of the martensitic transformation, as stated by the authors of the paper, but to the presence of an ω-phase. In martensite-hardened alloys with eutectoid-forming elements (Ti–Mn, Ti–Cr, Ti–Fe), the ω-phase is formed as a result of decay of the β-solid solution of these alloys. Alloys of this type are characterized by a short incubation period during which the β-solid solution is stable at 300–400°C (the temperatures of β-phase decay with formation of the ω-phase [12]). The $\beta_{hdh} \rightarrow \beta_1 + \omega$ transformation is not completely suppressed during hardening, and, together with the basic martensitic structure, there is a certain quantity of the ω-phase, which causes the rise in elastic modulus. Author

N69-14261*# Tyco Labs., Inc., Waltham, Mass.
STUDY OF THE GENERAL MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS AND DEVELOPMENT OF TECHNIQUES FOR ITS DETECTION Quarterly Report, 1 May–31 Aug. 1968
S. B. Brummer, R. O. Bell, F. H. Cocks, and A. Cordellos 31 Aug. 1968 59 p refs
(Contract NAS8-20297)
(NASA-CR-98205; QR-7) Avail: CFSTI CSCL 11F

This investigation examines the mechanism of the stress corrosion cracking of Al alloys and the feasibility of using instrumental methods to detect stress corrosion cracking on fabricated Al alloy parts. Emphasis has been placed on experiments to explore the effect of environment on the mode and rate of cracking of 7075 and on the reasons for the precorrosion susceptibility of the stress corrosion of this alloy. Studies have been made in 1M NaCl buffered to pH 4.7 and held at 30°C. In order to investigate the reason for the precorrosion susceptibility of 7075 and the processes occurring during the various stages of failure, we have carried out multiple interrupted load tests and interrupted tests with removal from solution and drying of the sample. The second phase of the program was to study the feasibility of detecting stress corrosion damage in fabricated Al alloy parts. This project aims to determine the range of detectability of stress corrosion damage and to specify components and procedures for an on-field instrument. The experimental technique involves attenuation of surface ultrasonic Rayleigh waves. Author

N69-14264# Bureau of Mines, Albany, Oreg. Thermodynamics Lab.
HEATS OF FORMATION OF CHROMIUM CARBIDES
Alla D. Mah Jan. 1969 13 p refs
(BM-RI-7217) Avail: Issuing Activity

Existing heats of formation for the carbides of chromium are based on equilibrium measurements. Values obtained by different investigators are in poor agreement. The present investigation is the first direct calorimetric determination of the heats of formation of the chromium carbides. Author

N69-14296# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Quarterly Progress Reports, 1 Jan.–30 Jun. 1968
R. N. Duncan, A. S. Mehner, H. H. Klepfer, and A. E. Pickett Jul. 1968 26 p refs
(Contract AT(04-3)-189)
(GEAP-5649; EURAEC-2056; QPR-20; QPR-21) Avail: CFSTI

A Zr + 2.0 at. % Cr + 0.16 At. % Fe alloy (Zr–Cr) is being evaluated as nuclear fuel cladding. Zr–Cr alloy-clad fuel rods are being irradiated to a target exposure of 15,000 to 20,000 MWd/tU. The rate of fuel burnup has been approximately 800 MWd/tU (average) per month of full-power operation. The Zr–Cr alloy-clad fuel rods have accumulated a total of approximately 8000 MWd/tU average exposure. This corresponds to about 7900 hours of high-temperature, full-power, reactor operation. The long-term, out-of-pile, loop corrosion tests are continuing satisfactorily. Zr–Cr alloy samples are being tested in the loop under heat transfer conditions, and have accumulated about 6800 hours exposure. Leak tests indicated the bundle was sound. Four sides of the bundle were visually examined, using a pool periscope. Nothing was observed that would indicate any degradation in either the Zr–Cr or Zircaloy-2 fuel rods. Author (NSA)

N69-14303# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.
RESIDUAL STRESS AND STRESS-CORROSION CRACKING OF TYPE-304 STAINLESS STEEL FUEL CLADDING
E. A. Lees, W. L. Denison, and V. E. Hazel May 1968 30 p refs
(Contract AT(04-3)-361)
(GEAP-4221) Avail: CFSTI

The results of residual stress measurements on archive cladding from Big Rock Point Power Reactor developmental fuel assemblies PO-1 to PO-4 are presented. Also presented are the results of residual stress and stress-corrosion cracking susceptibility of Type 304 stainless steel used in the High Power Density Project, Vallecitos Boiling Water Reactor irradiations. Author (NSA)

N69-14342# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SOME OBSERVATIONS ON THE ANNEALING OF NEUTRON IRRADIATED SINGLE CRYSTAL AND POLYCRYSTALLINE MOLYBDENUM
H. E. Kissinger, J. L. Brimhall, B. Mastel, and T. K. Bierlein 25 Jul. 1968 17 p refs Presented at Intern. Conf. on Vacancies and Interstitials in Metals, Juelich, W. Ger.
(Contract AT(45-1)-1830)
(BNWL-SA-1812; CONF-680910-2) Avail: CFSTI

After fast-neutron irradiation both single-crystal and polycrystalline Mo rods showed changes in length and lattice parameters. Electron microscopy indicated that defect clusters, or small dislocation loops, were smaller, 50 to 60 Å, in the polycrystalline rods as compared with 90 to 100 Å in the single crystals after a neutron influence of 1×10^{19} n/cm^2 although the lattice parameters changes were greater in the polycrystalline specimens. NSA

N69-14347# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
SODIUM COMPONENTS DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS Quarterly Progress Report, Mar.–May 1968
Jul. 1968 76 p refs
(Contract AT(04-3)-189)
(GEAP-5648; QPR-5) Avail: CFSTI

Work is reported on investigations of materials corrosion, mechanical properties, and sodium impurities in pumped sodium systems operating under controlled purity conditions to maximum

temperatures of 1300°F. Significant observations include decarburization in the 1200 to 1300°F region of an austenitic system and carburization within the same system at lower sodium temperatures, and a higher corrosion rate of Type 316 stainless steel in sodium at 1200 to 1300°F under heat transfer conditions compared to equivalent isothermal conditions. Author (NSA)

N69-14356# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MACHINES AND TECHNOLOGY IN METAL WORKING BY PRESSURE (SELECT ARTICLES)
2 Nov. 1967 16 p refs Transl. into ENGLISH from Tr. Mashiny i Tekhnol. Obrabotki Metallov Davleniyem, no. 263, 1966 p 39–47
(AD-677247; FTD-MT-264-67) Avail: CFSTI CSCL 11/6

CONTENTS:

1. INVESTIGATION OF PLASTICITY OF NIOBIUM ALLOY VN-2 K. N. Bogoyavlenskiy et al p 1–3 refs (See N69-14357 04-17)

2. PRODUCTION OF NICKEL-COPPER BIMETAL BY VACUUM ROLLING A. A. Aleksandrov et al p 5–11 refs (See N69-14358 04-17)

N69-14357# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF PLASTICITY OF NIOBIUM ALLOY VN-2 [ISSLEDOVANIYE PLASTICHNOSTI NIOBIYEVOGO SPLAVA VN-2]
K. N. Bogoyavlenskiy et al *In its* Machines and Technol. in Metal Working 2 Nov. 1967 p 1–3 refs (See N69-14356 04-17)
Avail: CFSTI

To ascertain the feasibility of forming thin-wall VN-2 niobium-alloy shapes, cold-rolled alloy specimens 70 mm long, 10 mm wide and 0.2 or 0.5 mm thick, cut at an angle of 0.45° or 90° to the direction of rolling, were tested in the as-rolled and vacuum-annealed (0.5 hr at 1000-1200) conditions. It was found that vacuum annealing lowered the hardness and strength from 95–107 kg/mm^2 and 225–245 kg/mm^2 to 55–90 kg/mm^2 and 165–200 kg/mm^2 respectively, depending on the annealing temperature. At the same time, the elongation increased from 1–2.5% for as-rolled alloy to 23–24% for specimens cut at an angle of 45°, and 15–19% for longitudinal and transverse specimens annealed at 1200°C. A considerable anistropy of mechanical properties was observed in annealed specimens. Specimens cast at 45° to the direction of rolling had a lower strength and a higher ductility than longitudinal and transverse specimens. The best combination of mechanical and technological properties of niobium-alloy sheets was attained by vacuum annealing (not in argon) at a temperature of 1100–1150°C. Thin-wall shapes can be formed from VN-2 alloy sheets 0.2 or 0.5 mm thick by bending, if the bend radius is maintained equal to or greater than the sheet thickness. Author

N69-14358# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRODUCTION OF NICKEL-COPPER BIMETAL BY VACUUM ROLLING [POLUCHENIYE BIMETALLA NIKEL'-MED' PROKATKOY V VAKUUME]
A. A. Aleksandrov et al *In its* Machines and Technol. in Metal Working 2 Nov. 1967 p 5–11 refs (See N69-14356 04-17)
Avail: CFSTI

M-1 grade copper and 99.99%-pure nickel sheets, 10 mm thick, vacuum annealed at 700 and 900°C, respectively, were slowly cooled, assembled into 20 × 40 × 100 mm packets, pack rolled in a vacuum of up to $1 \cdot 10^{-5}$ mm Hg at 750–1050°C with a 5–52% reduction, and investigated to determine the effect of the rolling temperature, depth of vacuum, and degree of reduction on the bond strength and microstructure. The highest bond strength, 24–25.5 kg/mm^2, was observed in composite sheets rolled with a 30% reduction in a vacuum of $1 \cdot 10^{-4}$ mm Hg at 1050–950°C and a packed width-to-height ratio of 1:2. The surface finish of the joined sheets had no effect on the bond strength of the composite metal. The bond strength was also practically unaffected by annealing at 400–600°C, but slightly decreased to 22–23 kg/mm^2 with annealing at 800–1000°C. The metal near the interface had a finer grain structure than the base metal. The specimens annealed at 900°C for 24 hr had a 28–40 thick intermediate layer, probably of a solid solution of copper in nickel. This indicated that the diffusion of copper into nickel was a predominant process in the rolling and annealing of composite metal. Author

N69-14388# Naval Research Lab., Washington, D. C.
HEAVY SECTION STEEL TOUGHNESS CHARACTERIZATION Semiannual Memorandum Progress Report
F. J. Loss Aug. 1968 24 p refs
(AD-677601; NRL-MR-1918) Avail: CFSTI CSCL 11/6

The report presents the initial progress of a research program to investigate the fracture toughness of heavy section steels as influenced by mechanical constraint and through-thickness metallurgical variations. The fracture toughness of the steels studied are defined primarily by means of the Dynamic Tear (DT) test developed by NRL for characterizing a wide variety of commercial steels. The present report describes the initial evaluations of two thicknesses of A-533B reactor grade steels and includes Charpy-V as well as DT results. The 6-3/8-in. thick A-533B Class II material is part of an existing NRL program while the 12-in. thick A-533B Class I material is part of the Atomic Energy Commissions Heavy Section Steel Technology Program. Author (TAB)

N69-14403*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REVIEW OF DUCTILIZING OF GROUP VIA ELEMENTS BY RHENIUM AND OTHER SOLUTES
William D. Klopp Washington Dec. 1968 36 p refs
(NASA-TN-D-4955) Avail: CFSTI CSCL 11F

The ductility of Group 6A alloys containing rhenium and other solutes from Groups 7A and 8A was reviewed. The rhenium ductilizing effect, found in Group 6A alloys containing 25 to 35 at. %Re, is promoted by other solutes from Group 7A and the early portions of Group 8A. The hardness minimums and lowered ductile-brittle transition temperatures observed in dilute Mo-Re and W-Re alloys are attributed to solution softening. This phenomenon occurs at low temperatures and is common to many dilute body-centered-cubic alloys containing substitutional solutes. Author

N69-14405# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
FATIGUE CRACK GROWTH IN NUCLEAR REACTOR PIPING STEELS
A. J. Brothers Mar. 1968 56 p refs
(Contract AT(04-3)-189)
(GEAP-5607) Avail: CFSTI

Fatigue crack growth rates were measured for three steels, Type-304 stainless, A-212B carbon steel, and chromium-molybdenum steel A387D, used for nuclear reactor piping, under variations in temperature, cyclic frequency, mean stress levels, and tension versus bend loading. The application of procedures for estimation of crack growth rates is discussed as a basis for structural design. NSA

N69-14428# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
RMI TITANIUM Semiannual Progress Summary Report, Jan.–Jun. 1968
R. L. Bean 8 Aug. 1968 56 p refs
(Contract AT(30-1)-1405)
(RMI-11) Avail: CFSTI

For increased metal utilization, the upset-forging process is applied for uranium fabrication. The operational problems and optimization of upset-forging as a production process are successful. Co-extrusion billets for Hanford have been processed. Parameters for the sizing of Oerter size fuel cores to dimensional specifications have been developed, successfully extruded, and sized to Mark VR Oerter precision extrusion tolerances. Studies were made of the effects of non-uniform cooling as a source of ovality using the vacuum furnace. Cold roll straightening of uranium was investigated as an economical and efficient alternative to warm roll straightening and is employed on Mark 30 production. A controlled comparison of the step seal and taper seal liners was made. The step seal liner was superior for precision extrusion. The taper seal liner will be used for regular production material. NSA

N69-14438# College of Aeronautics, Cranfield (England).
THE STRUCTURE AND PROPERTIES OF THE WELD HEAT AFFECTED ZONE IN 2 1/4 PERCENT CHROMIUM–1 PERCENT MOLYBDENUM STEELS
E. Smith, B. E. Blanchard, and R. L. Apps Jun. 1968 36 p refs
(COA-MATT-8) Avail: CFSTI

A study was made of the heat affected zone (HAZ) structures produced in a plain 2 1/4% CR-1% Mo steel and in a similar steel stabilized with additions of 1/2% Nb and 1/4% Ti. In the plain steel typical HAZ structures were reproduced in specimens 1 cm. square and 7.5 cm. long. The mechanical properties of these structures were evaluated by means of hardness, Charpy V-notch impact and tensile tests and the results compared with those of the parent plate. The hardness, transition temperature, proof stress, and U.T.S. increased continuously with increasing peak temperature of simulation. Welds were produced at two levels of heat input in the stabilized steel and the range of structures in the HAZ were studied by optical and electron microscopy. Microanalysis of the phases and inclusions present was used in an attempt to assess changes occurring during welding. Microhardness surveys across the HAZ were made and the effect of a tempering treatment at 690°C was studied. Maximum hardness was located in the grain coarsened region, with a continuous decrease on moving away from the fusion boundary. The tempering treatment caused an increase in the peak hardness, but a decrease in hardness in the other regions of the HAZ. Author

N69-14472# National Academy of Sciences-National Research Council, Washington, D. C. Materials Advisory Board.
APPLICATION OF SCIENCE AND TECHNOLOGY TO METALWORKING Final Report
Sep. 1968 31 p refs
(Contract DA-49-083-OSA-3131)
(AD-677718; MAB-245) Avail: CFSTI CSCL 11/6

Contents: High pressure forming; The General Electric Company's contact-bend-stretch mill; The problems and needs for titanium mill products and shapes in the aerospace industry; Procedures and philosophy adopted by the panel. TAB

N69-14497# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHANGES IN PROPERTIES OF THIN METALLIC FILM COATINGS BY MECHANICAL AND THERMAL TREATMENT
I. K. Sinishchuk 13 Nov. 1967 10 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR: Ser. Fiz.-Tekh. Navuk (Minsk), no. 4, 1965 p 57–61
(AD-677353; FTD-HT-23-1271-67) Avail: CFSTI CSCL 11/6

The author demonstrates the possibility of raising the density of films of zinc, cadmium, and copper to that of the bulk material. The experiments were carried out on zinc and cadmium films sputtered on quartz substrates at reduced pressures. The experiments have shown that the increase in density of the films follows the same pattern as the increase of density of powders, and is described by an exponential function, for which the formula is given. Annealing in hydrogen leads to stabilization of the electric properties of the deformed films. Author (TAB)

N69-14499# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE EFFECT OF THE DEFORMATION RATE ON CORROSION RESISTANCE OF METALS
V. G. Kononenko 18 Dec. 1967 10 p Transl. into ENGLISH from Samoletostroyeniye i Tekhn. Vozdushnogo Flota, no. 4, 1965 p 110–115
(AD-677235; FTD-HT-23-1152-67) Avail: CFSTI CSCL 11/6

Comparative experiments are conducted to determine corrosion stability as a function of the rate and temperature of deformation in various structural materials made from carbon, alloy and stainless steels as well as aluminum and magnesium alloys. Annealed cylindrical specimens 12 mm in diameter and 18 mm long were deformed by upsetting. The specimens were then placed in a corrosive medium (sulfuric acid) for a maximum period of 2-1/2 hours. Tables are given showing corrosion as a function of time. Author (TAB)

N69-14500# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF TITANIUM ON THE PHASE COMPOSITION OF FERRITIC-AUSTENITIC STAINLESS STEEL
A. P. Gulyayev et al 18 Dec. 1967 6 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Inst. Chernoy Met. Sb. Trudov (Moscow), no. 46, 1966 p 37–40
(AD-677234; FTD-HT-23-1146-67) Avail: CFSTI CSCL 11/6

The effect of 0.4% titanium on the phase composition and mechanical properties of OKh18G8N2T stainless steel was studied. Steel samples were quenched from 1200C and aged to temperatures up to 900C. Impact strength, hardness and saturation magnetization were given as functions of tempering temperature; the addition of titanium did not change these properties. Author (TAB)

N69-14572# Boeing Co., Renton, Wash. Commercial Airplane Div.
X-RAY DIFFRACTION STUDY OF RESIDUAL MICROSTRESSES IN SHOT-PEENED AND FATIGUED 4130 STEEL
A. L. Esquivel and K. R. Evans Oct. 1968 40 p refs Presented at the Spring Meeting of Soc. for Exptl. Stress Anal., Albany, N. Y., 9 May 1968
(AD-677445; D6-23377) Avail: Issuing Activity CSCL 11/6

A study was made of the effects of shot peening and fatigue cycling on the residual macrostresses determined by X-ray methods in an austenitized and tempered AISI 4130 steel (150-170 ksi). The results show that the effect of shot peening is to produce a residual compressive macrostress layer .014 inch deep. The residual stress profile (stress versus depth) exhibits a small negative stress gradient at and near the surface and a large positive stress gradient in the interior. Stress relaxation (due to fatigue cycling) which occurred early in the fatigue history of the specimen was found greater at the surface than in the sub-surface layers. Stress gradients of the stress profile increased with continued cycling and varied with depth. A correlation appears to exist between stress relaxation and stress gradients at the surface. Author (TAB)

N69-14598# Massachusetts Inst. of Tech., Cambridge. Casting and Solidification Section.
EFFECTS OF INGOT STRUCTURE AND THERMO-MECHANICAL PROCESSING ON PROPERTIES OF WROUGHT 7075 ALLOY Final Report, Jun. 1967–1 Jun. 1968

Shree N. Singh and Merton C. Flemings Jun. 1968 134 p refs
(Contract DA-19-020-ARO(D)-5707(A))
(AD-677164) Avail: CFSTI CSCL 11/6

Results are presented of a detailed study on the combined influences of ingot dendrite arm spacing and thermomechanical treatments on structure and properties of wrought high purity 7075 alloy. Author (TAB)

N69-14651*# Lockheed-Georgia Co., Marietta. Nuclear Products.
EFFECTS OF INTERIM WARMING ON TENSILE PROPERTIES OF A 286 STAINLESS STEEL IRRADIATED AT CRYOGENIC TEMPERATURES
Oct. 1968 45 p refs
(Contract NAS3-10298)
(NASA-CR-72475; LAC-ER-10008) Avail: CFSTI CSCL 11F

This report describes the results obtained in an experimental study of the effects of irradiation on the tensile properties of Type A-286 stainless steel, AMS 5735, at cryogenic temperatures. Test specimens were exposed to fluences of 6×10^{17} n/cm^2 and 9×10^{17} n/cm^2, with neutron energies greater than 0.5 MeV (60 femtojoules), at 17°K (30°R). Sets of specimens were irradiated continuously to the desired fluence; other sets were irradiated in increments of 3×10^{17} n/cm^2, with interim warming to 300°K (540R), until the desired fluence was attained. The interim temperature was maintained for one hour between incremental irradiations. The sample lots tested after continuous irradiation exposure showed no effect of irradiation on the ultimate tensile strength reliably discernable within the sensitivity of the test procedures. A small increase in the tensile yield strength was observed with increasing fluences; no such effect had been observed after exposure to 1×10^{17} n/cm^2 at 17°K (30°R) in an earlier program. The effect of total irradiation fluence on the tensile yield strength appeared to be independent of interim warming during interrupted irradiations at the 95% confidence level (probability of obtaining a value equal to ± the desired significance ratio is 0.05). Author

N69-14655# National Inst. for Metallurgy, Johannesburg (South Africa).
DETERMINATION OF CARBON IN URANIUM TETRAFLUORIDE
C. E. Austen, H. Stoch, and T. W. Steele 8 Nov. 1967 9 p
(NIM-256) Avail: Issuing Activity

A method was developed for the determination of more than 10 ppM carbon in UF_4. After drying at 110C the UF_4 is heated in a stream of oxygen in a combustion tube. The fluorine evolved is absorbed by MgO. The CO_2 formed is absorbed in a dilute NaOH solution and determined conductometrically. NSA

N69-14670*# American Machine and Foundry Co., Alexandria, Va.
DEVELOPMENT OF LIGHT WEIGHT MAGNESIUM ALLOYS FOR LOW TEMPERATURE APPLICATIONS. Final Summary Report, Mar. 21, 1966–Mar. 25, 1967
H. W. Leavenworth, Jr. and F. J. Dunkerley 20 Mar. 1967 107 p refs
(Contract NAS8-11168)
(NASA-CR-98210) Avail: CFSTI CSCL 11F

Three alloys, having the nominal compositions, II4 (Mg + 1Zr + 3Th + 6Zn + 5Cd + 6Ag + 7Li), IA6 (Mg + 3Th + 9Li + 2Zn + 4Al + 4Ag + 1Mn), and ZLH 972 (Mg + 9Zn + 7Li + 2Th) were found, when properly processed and heat treated, to satisfy the major strength–ductility goals of the contract as well as most of the other specified fabrication characteristics. All three alloys exhibit better than 90% welding efficiency by conventional MIG or TIG methods, are readily machinable, can be readily chemically milled, respond well to all conventional metal forming operations (except that ZLH 972 is not readily extruded), and have notch/unnotched tensile ratios of 1.0 and 0.9 at 68° and −452°F respectively. Other physical-mechanical properties of all these alloys, and especially the II4 composition, are also presented to implement their prospective commercial exploitation. An adherent fused salt chemical conversion coating was developed both for corrosion protection and as a paint base. Corrosion data in sea water indicate the coating has excellent sea environment corrosion protection characteristics. Author

N69-14681# Martin Co., Denver, Colo.
CENTER FOR HIGH ENERGY FORMING. Quarterly Technical Progress Report
Jimmy D. Mote 1 Oct. 1968 20 p Prepared in cooperation with Denver Univ., Colo.
(Contract DA-19-066-AMC-266(X); ARPA Order 720)
(AD-677424; AMRA-CR-66-05/16; QTPR-13) Avail: CFSTI CSCL 13/8

The analysis for the impulse delivered to a blank using a modified Taylor analysis was programmed in Fortran IV language and compiled. The next quarters effort will be devoted to checking out the program and comparing theoretical results with experimental measurements. An improved technique for bonding strain gages was developed which provides strain measurements on explosively deformed blanks up to 5.5%. Initial experimental work was initiated on the energy delivered to dies. Additional results on strain rate effects is reported. The preliminary work on explosive forming and punching of armor was started. The safety system for the capacitor bank has been installed and is operational. Preliminary results on the effect of explosive forming on stress corrosion cracking, terminal materials properties, and recovery and recrystallization are reported. Recent results on the mechanics of energy transfer and high velocity metal deformation are reported. Author (TAB)

N69-14689# Battelle Memorial Inst., Geneva (Switzerland).
THE SEARCH FOR A CERAMIC CRUCIBLE MATERIAL FOR URANIUM SMELTING [RECHERCHE D'UN MATERIAU CERAMIQUE DE CREUSET POUR LA FUSION DE L'URANIUM]
P. Lanaspeze and H. Tannenberger Sep. 1968 94 p refs In FRENCH
(Contract EURATOM-003-65-6-RCIS)
(EUR-3614f) Avail: CFSTI

The object of the study was to seek a ceramic material which was to be as inert as possible with respect to molten uranium. From a possible combination of those ceramics which are thermodynamically most stable, a first choice based on oxides was made and eight solid solutions or combinations arising from the following five oxides were examined. BeO, CaO, SrO, UO_2 and La_2O_3. Author

N69-14696# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanics.
THE ROLE OF FRICTION IN PLANE-STRAIN AND AXISYMMETRIC EXTRUSION PROBLEMS
C. T. Chen and F. F. Ling Wright-Patterson AFB, Ohio AF Mater. Lab. May 1968 58 p refs
(Contract AF 33(615)-3378)
(AD-677723; AFML-TR-68-105) Avail: CFSTI CSCL 13/8

Extrusion processes through three basic types of curved dies have been treated: cosine, elliptic and hyperbolic. Upper-bound theorem is used in obtaining mean extrusion pressures and also in choosing the most suitable deformation pattern for extrusion through square dies. Both Tresca and Mises yield criteria have been used and consideration has been given to friction at the die-material interface. Results are given in analytical form and plotted over a wide range of process variables. Author (TAB)

N69-14712*# Sylvania Electric Products, Inc., Towanda, Pa. Chemical and Metallurgical Div.
DEVELOPMENT OF COBALT-BASE DISPERSION-STRENGTHENED ALLOYS Final Report, 1 Jun. 1965–31 Jul. 1967
R. F. Cheney and W. Scheithauer, Jr. 15 Dec. 1968 175 p refs
(Contract NAS3-7611)
(NASA-CR-54599; SYLTT-549) Avail: CFSTI CSCL 11F

The Co–20Cr–11Ni–8Mo powders with dispersions of 0 to 6v/o ThO_2, CaO, or Y_2O_3 were made by spray drying and selective reduction. Compacts were extruded and then worked by swaging. Only ThO_2 gave a good dispersion with mean diameters from 110Å to 280Å and planar interparticle spacings from 1218Å to 2530Å. Exposure at 1185°C for 100 hours increased the mean diameters about 60Å. Despite the dispersions, rupture lives at 1095°C were poor. Deformation–anneal processing made little improvement. Low strengths and poor fabricability were attributed to the matrix transformation from fcc to hcp at strains greater than 10%. Author

N69-14714 Lehigh Univ., Bethlehem, Pa.
ELEVATED TEMPERATURE COMPRESSION DEFORMATION BEHAVIOR OF TUNGSTEN CARBIDE–COBALT ALLOYS
James Thomas Smith (Ph.D. Thesis) 1967 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-4909

The compressive creep deformation of two phase tungsten carbide–cobalt alloys has been investigated at temperatures of 800°, 900°, and 1000°C for stresses of 10,000 psi to 110,000 psi. The alloy morphology consists of WC particles dispersed in the Co matrix. Five alloys with controlled WC particle sized were investigated. At each temperature studied, the WC-12% Co alloys showed a decreasing steady state creep rate with increasing WC particle sizes for low creep stress levels. At high stress levels, the steady state creep rate was observed to increase with increased WC particle size. The possibility of WC particle deformation during creep was investigated by light microscopy and electron microscopy techniques. No evidence of particle fracture or slip was found. A discussion of strain rate and its influence on WC deformation was presented. It was concluded the creep rate was not sufficiently fast to cause particle deformation. Dissert. Abstr.

N69-14718# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
INTERNAL FRICTION CAUSED BY PLASTIC DEFORMATION
Ivar Holwech Aug. 1968 38 p refs
(AD-677546; D1-82-0731) Avail: CFSTI CSCL 11/6

The present work consists of two separate parts. In the first part, an attempt is made to give a picture of the general behavior of the effect on the basis of a series of different experiments on pure aluminum. The second part consists of a reformulation and simplification of the theory of internal friction caused by viscously damped dislocations. Author (TAB)

N69-14745# Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.
VANADIUM PURIFICATION Quarterly Progress Report, 1 Apr.–30 Jun. 1968
C. T. Wang, E. F. Barock, J. C. La Vake, and S. S. Christopher Aug. 1968 29 p
(Contract AT(30-1)-3742)
(CEND-3742-342; QPR-7) Avail: CFSTI

Production amounted to 22 pounds of 0.040-inch thick, high purity V–15Cr–5Ti alloy sheet. A heat-treating study was performed on the high purity sheet material to determine the recrystallization temperature and to compare the heat-treating response of this material to high interstitial material evaluated by Argonne National Laboratory. Based on this evaluation, the recrystallization temperature for the low interstitial material was determined to be 1050°C for a 1-hour anneal. Mechanical testing has started on the as-received and recrystallized material. Author (NSA)

N69-14752# United Kingdom Atomic Energy Authority, Culham (England).
SOME OBSERVATIONS ON THE OUT-GASSING OF STAINLESS STEEL FOLLOWING DIFFERENT METHODS OF CLEANING
R. S. Barton and R. P. Govier Mar. 1968 15 p refs
(CLM-R-93) Avail: CFSTI

The quantity and temperature dependence of gas released by stainless steel in vacuo following various forms of cleaning have been investigated using a high resolution mass spectrometer. The samples to be studied were introduced through a series of vacuum locks into a small oven attached to the ion source of the mass spectrometer. Each sample was heated over a period of four hours to a temperature of 450°C at which it was maintained for 16 hours. After cooling it was exposed to the air for 24 hours and the amount of gas readsorbed was investigated by an identical procedure. Author (NSA)

N69-14753# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy.
TRANSFORMATION CHARACTERISTICS OF ZIRCONIUM–NIOBIUM AND OTHER ALLOYS
A. J. Perkins, W. A. Jackson, and R. F. Hehemann Jul. 1968 35 p refs
(Contract AT(11-1)-588)
(COO-588-14) Avail: CFSTI

During the past year studies have been initiated to explore the relationship between diffusionless transformation and classical martensitic reactions. The systems chosen for these studies involved continuation of work on Zr–Nb alloys and initiation of studies on the Hf–Nb system and the intermetallic compound Ti–Ni. Transmission microscopy and other studies revealed that an athermal omega reaction occurs in a Hf–32% Nb alloy. The diffuse streaking and other characteristics of this alloy are completely analogous to the corresponding behavior of a Zr–25% Nb alloy. The intermetallic compound Ti–Ni exhibits a classical martensitic reaction at temperatures near room temperature and a transition phase at temperatures above M_s which exhibits the diffuse streaking, reversibility and negative temperature coefficient of resistivity characteristic of omega in Ti and Zr alloys. Author (NSA)

N69-14769# Royal Aircraft Establishment, Farnborough (England).
VACUUM DEPOSITION OF ADHERENT CADMIUM LAYERS ON STEEL
J. Harvey Mar. 1968 31 p refs
(RAE-TR-68053) Avail: CFSTI

A method is described for coating steels with an adherent layer cadmium by vacuum deposition; thus avoiding the hydrogen embrittlement problem which is associated with cadmium electroplating. The vacuum deposited coatings pass the tests normally applied to cadmium electroplate and the results of salt-spray corrosion tests suggest that they offer better protection than electroplate of the same thickness. This process is now being used to coat certain steel parts for aircraft. Author

N69-14794# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HOT-SHORTNESS OF NONFERROUS METALS AND ALLOYS
I. I. Novikov 22 Mar. 1968 403 p refs Transl. into ENGLISH of the book "Goryachelomkost' Tsvetnykh Metallov i Splavov" Moscow, Izd-Vo Nauka, 1966 p 1–299
(AD-677354; FTD-MT-24-333-67) Avail: CFSTI CSCL 11/6

In monograph there is given a systematic account of questions on the problem of hot-shortness - tendency of metals and alloys to brittle intercrystalline fracture with the presence of liquid phase along grain boundaries widely spread during casting and welding and encountered during hot working, heat treatment, and operation of articles from heat-resistant alloys. Author (TAB)

N69-14873*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRAIN RATE SENSITIVITY OF THREE TITANIUM ALLOY SHEET MATERIALS AFTER PROLONGED EXPOSURE AT 550°F (561°K)
Robert M. Baucom Washington Jan. 1969 33 p refs
(NASA-TN-D-4981) Avail: CFSTI CSCL 11F

Results are presented of an investigation of the effects of strain rate on three titanium-alloy sheet materials before and after prolonged exposure without stress at 550°F (561°K). The strain-rate sensitivity of the three alloys, Ti–8Al–1Mo–1V, Ti–4Al–3Mo–1V, and Ti–6Al–4V, was determined from the results of tensile tests performed at three strain rates on smooth and V-notched specimens. Little change in the tensile properties of smooth and V-notched specimens was observed at any given strain rate during accumulated exposure times up to 22,000 hours. This result indicates that the alloys under investigation are apparently stable for the exposures noted. The effect of an increase in strain rate on the tensile properties was generally a moderate increase in strength for each of the alloys. The sensitivity of Ti–8Al–1Mo–1V and Ti–4Al–3Mo–1V to sharp notches tended to decrease with an increase in strain rate. Author

N69-14978*# Texas Technological Coll., Lubbock. Dept. of Mechanical Engineering.
RESIDUAL STRESS MEASUREMENT OF TITANIUM–6Al–4V ALLOY PRESSURE VESSEL MATERIAL
P. K. Kol 20 Dec. 1968 9 p
(Contract NAS9-9019)
(NASA-CR-92446) Avail: CFSTI CSCL 11F

A diffractometer and an X-ray stress measurement attachment were used for nondestructive measurement of directional elastic residual stresses on the surfaces of 6Al–4V titanium alloy weldments and parent metal. In general, compressive stresses were found on both surfaces of the samples, although in some samples tensile stresses were observed in welds and heat affected zones. Examination of a weldment where large offsets or mismatch occurred during welding showed high tensile residual stresses in the cross section exceeding the uniaxial yield strength of the material. Stresses of this magnitude could be quite important in crack propagation analysis. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N69-14003*# Dynamic Science Corp., Monrovia, Calif.
EVALUATION OF IGNITION MECHANISMS IN SELECTED SPACECRAFT MATERIALS Final Report, 1 Mar.–30 Jun. 1967
M. Gerstein and W. R. Yates Aug. 1967 50 p refs
(Contract NAS9-6873)
(NASA-CR 92403) Avail: CFSTI CSCL 11I

The present study was undertaken to identify ignition mechanisms for typical spacecraft meterials in simulated operating environments. Accordingly, a variety of polymeric materials characteristically used in space cabin construction were tested in a small volume system containing pure oxygen at 5 psia. Among those variables receiving particular attention were the type of ignition source (both electrical and thermal) thermal behavior of the samples, locus of ignition, relative position of the test sample and energy sources, and the effect of various contaminating liquids. Ignition was shown to occur in the vapor phase in the flammable decomposition products released by thermal degradation of the samples. Purely thermal ignition occurred above 450°F. for all of the solid materials studied, while ignition of samples soaked with glycol or MEK displayed ignition properties characteristic of the liquids. High voltage sparks drastically reduced the temperatures required for ignition. Ignition in wire-overload tests occurred as a result of impingement of molten and burning particles of metal and insulation, and not by direct transfer of energy from the arc. Author

N69-14098# Georgia Univ., Athens. Dept. of Physics.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION
W. C. Sears 18 Sep. 1968 11 p refs
(Contract AT(40-1)-2418)
(ORO-2418-5) Avail: CFSTI

Changes in molecular structure produced by high-energy radiation were investigated for different organic polymers. Changes in saturation, polymer crystallinity, crosslinking, and scission were determined by infrared spectroscopy. Some results for butadiene polymers are given. NSA

N69-14135# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTEMPORARY TECHNOLOGICAL LUBRICATING OILS
V. V. Panov et al 29 Nov. 1967 111 p refs Transl. into ENGLISH of the book "Smazochnyye Masla Souramennoy Tekhniki" Moscow, Nauka, 1965 p 1–131
(AD-677245; FTD-MT-24-111-67) Avail: CFSTI CSCL 11/8

This booklet provides basic information on the composition and properties of present-day petroleum-base and synthetic lubricants, mostly oils, and on their applications. Polyphenyl oils are discussed. Synthesis, chemical and physicochemical properties, thermal and thermal-oxidative stability, and lubricity are touched on. It is stated that: Polyphenyl oils have not yet found wide application, because polyphenyl ethers have not been studied thoroughly. Polyphenyl oils are considered as promising lubricants for service at high temperature, e.g., in high-performance supersonic jet engines. Polyphenyl oils are beginning to find application as heat- and radiation-resistant hydraulic fluids. Author (TAB)

N69-14187 Pennsylvania State Univ., University Park.
DYNAMIC MECHANICAL BEHAVIOR OF GRAPHITES AND CARBONS
Raymond Ellory Taylor (Ph.D. Thesis) 1967 245 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.20 Order No. 68-3565

The stress-amplitude independent internal friction and dynamic modulus of pitch-bonded natural graphite crystals, commercial graphites, as-deposited pyrolytic carbon, stress-annealed pyrolytic carbon, and vitreous carbon were investigated from 4 to 750°K. Specific objectives included the establishment of a relatively consistent comparative pattern of their dynamic mechanical behavior, the delineation of the portion of behavior related to the crystalline regions from the portion due to the non-crystalline regions, and the determination of the effects of low-dose reactor irradiation and annealing on the behavior. Dissert. Abstr.

N69-14228# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
FOAM AND DRY CHEMICAL APPLICATION EXPERIMENTS Interim Report

George B. Geyer Dec. 1968 56 p refs
(NA-68-34; RD-68-55) Avail: Issuing Activity

Full-scale tests were conducted under fixed fire conditions employing air-aspirating foam and dry powder dispensing equipment in which six different foam agents and three different dry chemical powders were evaluated, both alone and in combination. The time required to control circular pool fires of 40, 60, and 80 feet in diameter, containing an obstacle and a three-dimensional fire, was determined. Author

N69-14257*# Los Alamos Scientific Lab., N. Mex.
CMF-13 RESEARCH ON CARBON AND GRAPHITE Progress Summary Report, 1 Aug.–31 Oct. 1968
Morton G. Smith 31 Dec. 1968 37 p refs Sponsored in part by NASA
(Contract W-7405-ENG-36)
(NASA-CR-98663; LA-4057-MS; PSR-7) Avail: CFSTI CSCL 07D

Progress is reported in studies whose aim it is to increase understanding of carbon and graphite properties and behavior as engineering materials, to improve raw materials and processes used in their manufacture, and to produce them with consistent, predictable, and useful combinations of properties. The microstructural studies to characterize natural, commercial, and experimental carbons and graphites involved such techniques as X-ray diffraction, electron and optical microscopy, and porosimetry. Physical and mechanical properties were measured as functions of formulation, treatment, and environmental variables, and correlations were sought among properties and structures. Materials and techniques were varied systematically to create internal structures believed to be responsible for desirable properties. The publications relating to carbons and graphites which have resulted from these studies are also listed. K.W.

N69-14276*# California Univ., Los Angeles. Dept. of Engineering.
RIGIDITY PROPERTIES OF A THREE-WAY PRESTRESSED SEGMENTED CERAMIC PLATE
C. P. Chen and R. B. Matthiesen Sep. 1968 59 p refs
(Grants NsG-423; NsG-427)
(NASA-CR-98654; Rept-68-57) Avail: CFSTI CSCL 11B

Experimental methods used in an investigation of a three-way prestressed ceramic plate comprised of triangular segments are discussed. The rigidity properties of interest were the bending, twisting and Poisson rigidity constants D_x, D_y, D_{xy}, and D_λ in three coplanar directions with an angle of 120 degrees from one to another. The experimentation involved two cylindrical bending tests to determine the flexural rigidities D_x and D_y, a twisting test to obtain the twisting rigidity D_{xy}, and an anticlastic bending test to examine the Poisson's rigidity D_λ. The results of experiments on the hexagonal ceramic plate prestressed in three directions are presented and compared with the ordinary theory of orthotropic plates. The results indicate that the plate has three sets of "principal" axes in the plane. Author

N69-14349# Rohm and Haas Co., Warren, R. I. Rhee Div.
DEVELOPMENT OF A LIGHTWEIGHT BUTYL-COATED STRETCH FABRIC Final Report, 6 Oct. 1966–6 Apr. 1968
James P. Shelley Natick, Mass. Army Natick Labs. Apr. 1968 37 p *Its* Ser. C&OM-48
(Contract DAAG17-67-C-0009)
(AD-677118; NLABS-TR-68-63-CM) Avail: CFSTI CSCL 6/17

The report discusses the development of a technique for the application of multiple thin layers of butyl rubber on a stretch nylon substrate. Several variations in the process designed to minimize fabric handling were explored. Author (TAB)

N69-14400*# Westinghouse Electric Corp., Lima, Ohio.
MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE
R. E. Stapleton Washington NASA Dec. 1968 129 p refs
(Contract NAS3-6465)
(NASA-CR-1213; WAED-67-24E) Avail: CFSTI CSCL 09A

Four candidate high-purity dielectric materials were fabricated into thin wafer, test capacitors and their electrical properties were measured in vacuum at temperatures up to 1100°F. These materials included: pyrolytic boron nitride, single crystal Al_2O_3, hot-pressed BeO, and polycrystalline Al_2O_3. The data shows that pyrolytic boron nitride (PBN) has superior electrical properties over the temperature range and can be fabricated into very thin (<0.001 inch) large area capacitor wafers. A number of multi-layer capacitors (pyrolytic boron nitride dielectric) have been designed and evaluated at temperatures up to 1100°F. Sputtered, thin film electrodes were used on all devices. The feasibility of interconnecting these electrodes without supplementary metal foil tabs has been demonstrated. An extended life test was successfully completed on a five wafer pyrolytic boron nitride (PBN) capacitor at 1100°F in vacuum. Author

N69-14401# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CHARACTERIZATION OF RECENTLY DEVELOPED HIGH TEMPERATURE POLYMERS: RADIATION RESISTANCE OF POLYIMIDE AT ELEVATED TEMPERATURES
N. R. Gordon and N. R. Langley Jul. 1968 8 p
(Contract AT(45-1)-1830)
(BNWL-866) Avail: CFSTI

The effect of γ radiation on the mechanical properties of a glass-reinforced polyimide plastic at elevated temperatures was analyzed. No systematic effect was found from γ radiation doses up to 10^9 R on the modulus of elasticity or strength at constant test temperature. Heat treating the polyimide before irradiation produced improved mechanical properties. Exclusion of air to eliminate oxidative degradation during irradiation contributed no improvement. The mechanical performance of the plastic at elevated temperatures is maintained in radiation environment to doses of at least 10^9 R permitting the use of the polyimide in nuclear reactor application. NSA

N69-14647# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
AN ANALYSIS OF RADIATION INDUCED FAILURE MECHANISMS IN RADIOLUMINESCENT SWITCH TIPS
M. L. Rossi Dec. 1968 28 p refs
(RE-351) Avail: Issuing Activity

An investigation has been made of potential radiation problems associated with the use of the beta (β) source Promethium-147 (Pm^{147}) with phosphors in a core material mix to produce luminescence in platic switch tips such as those used in the Lunar Module (LM) vehicles. Of specific concern was the possible release of ceramic microspheres containing Pm^{147} and, worse, the release of Pm^{147} directly. Our theoretical results indicate that both the Acrylic and the Kel–F plastics used as switch tip materials suffer chain scissions when irradiated, with evolution of gas that can effect release of the microspheres through a buildup of pressure that causes an epoxy plug to shear, and through oxidation that causes the epoxy to soften. In addition, the fluorine produced in irradiated Kel–F can attack the ceramic microspheres with a resulting direct release of Pm^{147}. A recommended solution to this problem is to protect the epoxy and the plastic from the β radiation by enclosing the core material in a transparent, inorganic, cylindrical shell that can then be inserted into the switch tip. Author

N69-14858# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Chemistry and Chemical Engineering.
RHEO-OPTICAL BEHAVIOR OF POLYACRYLONITRILE: CREEP AND CREEP RECOVERY
R. D. Andrews and H. Okuyama 27 Aug. 1968 31 p refs Submitted for Publication
(Contract N00014-68-A-0131)
(AD-677646; TR-1) Avail: CFSTI CSCL 11/9

The rheo-optical behavior of PAN homopolymer film has been investigated by means of creep and creep recovery experiments with simultaneous measurements of birefringence changes. A progressive change in shape of the creep curve in a log-log plot of compliance vs time is seen: from very flat and gradual to more S-shaped both with increasing temperature, and with increasing stress at the higher temperatures. This S-shaped curve can be identified with the cold-drawing phenomenon, even though no neck formation was seen. Creep recovery is more complete at lower temperatures and after lower final strains in the creep experiment. Most of the recovery is instantaneous; only a very small amount of further time-dependent recovery is observed. At higher temperatures and higher strains, creep seems to involve permanent changes in the solid-state structure; these produce a permanent set which is not recoverable even on heating to higher temperatures. The creep and creep recovery therefore cannot be properly described in terms of the laws of simple viscoelasticity. The rheo-optical behavior of this polymer is clearly more complex than that of PVC, which has been investigated previously. Some speculations regarding the solid-state structure of PAN are presented, based primarily on the birefringence results. Author (TAB)

N69-14675# Battelle Memorial Inst., Columbus, Ohio.
IMPROVED COAXIAL AND MULTICONDUCTOR CABLE MATERIALS
R. M. Kell, Bailey Bennett, and P. B. Stickney [1968] 15 p refs Presented at the 17th Intern. Wire and Cable Symp., Atlantic City, 4–6 Dec. 1968
(AD-677166) Avail: CFSTI CSCL 9/1

An investigation has been made of the performance of several polymeric materials in relationship to their possible application in construction of cables for extreme environments. Data are presented showing the advantages and limitations of these materials and how they are contributing to the design of new cables. Author (TAB)

N69-14764*# Texas Univ., Austin.
FORCE-PENETRATION CHARACTERISTICS OF A SAND HORIZONTALLY PENETRATED BY PLATES, CONES, AND SPHERICAL SEGMENTS
Paul A. Hustad and William R. Cox Washington NASA Jan. 1969 217 p refs
(Grant NsG-604)
(NASA-CR-1252) Avail: CFSTI CSCL 08M

The influence of time upon the force-penetration characteristics of sand was determined by varying the velocity at which the models penetrated into the backfills. Three separate phases of laboratory testing were included. The first consisted of designing a test setup and performing pilot tests that simulated the classical plane-strain earth-pressure problem. The second phase utilized much the same type of loading apparatus as that used in Phase I. Two heights of walls, 1 ft and 1.5 ft, were penetrated at various constant velocities into loose and dense backfills. For the range of velocities that were utilized, the observations showed that the time effects were negligible. The third phase utilized two sizes of right-circular cones and spherical segments which were penetrated into backfills horizontally supported by polyethylene membranes. The rate and vertical depth below the soil surface at which the models penetrated the loose and dense backfills were varied. The same general range of velocities as in Phase II were utilized, and it was found that the time effects were negligible. Equations are presented that provide a means of predicting the maximum horizontal and vertical soil reactions. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N69-13860 New Mexico Univ., Albuquerque.
THE APPROXIMATION OF EIGENVALUES AND EIGENFUNCTIONS OF CONVOLUTION KERNELS
Adelbert Lee Roark (Ph.D. Thesis) 1967 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-3480

The problem of approximating the eigenvalues and eigenfunctions of certain displacement integral equations is considered. Particular interest is directed to kernels which become highly oscillatory as the positive parameter becomes large since conventional numerical methods are not satisfactory. Specific numerical examples which have been considered in the literature are discussed. They illustrate the usefulness and accuracy which can be achieved by the use of this method. Dissert. Abstr.

N69-13963 Princeton Univ., N. J.
ENVELOPES OF HOLOMORPHY WITH SINGULARITIES
Charles Edward Stenard (Ph.D. Thesis) 1967 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-2520

A study of analytic continuation of holomorphic functions of several complex variables is made from the point of view of investigating the structure of the spectrum of a uniformly closed algebra of holomorphic functions defined on an analytic space. It is the aim of this approach to place an analytic structure in the spectrum which is compatible with the Gelfand extension of the algebra. Admissible analytic structures are defined, and the important questions of existence and uniqueness of maximal structures are analyzed. A generalization of Remmert's proper mapping theorem is introduced and employed in the study of the behavior of the Gelfand extension on a maximal admissible structure, particularly with respect to whether the structure is Stein and to whether the extended algebra attains the full algebra of holomorphic functions. Dissert. Abstr.

N69-13964 New Mexico Univ., Albuquerque.
COMPLETION AND COMPACTIFICATION FUNCTORS FOR CAUCHY SPACES
James Francis Ramaley (Ph.D. Thesis) 1967 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-3478

Categorical arguments and constructions to the categories of convergence spaces, uniform convergence spaces, and Cauchy spaces are applied. If F(E) is the set of all filters on a set E, a convergence structure on E may be defined to be a relation q from F(E) to E, subject to some very general restrictions. Just as the notion of a convergence structure on E generalizes that of a topology on E, a uniform convergence space is the analogous generalization of a uniform space. The Cauchy structures are new and are intended to generalize the notion of a family of Cauchy filters on a set. Definitions and results from category theory that will be of value are given with particular discussion of adjoint functors. Convergence structures are defined, and the hierarchy of convergence structures (quasi-topology, limit space, Choquet space (pseudo-topology), neighborhood space, topology) is supplied. A number of axioms that express separation, uniformity, or regularity properties of a convergence space are listed, and the various implications among these axioms are established. The important definition of the paper is that of a Cauchy structure (which combines properties of Cauchy filters in the usual sense with properties of fundamental filters) which is given along with some examples. The primary result is the construction of a regular, T_1, coreflective completion for any Cauchy space. A similar construction for compactifications is given and the question: "When is the completion compact?" is partially answered. Both constructions are of the Wallman type. Dissert. Abstr.

N69-13981 Maryland Univ., College Park.
DISCRETE ANALOGS FOR MIXED BOUNDARY VALUE PROBLEMS OF ELLIPTIC TYPE

Vaithilingam Thuraisamy (Ph.D. Thesis) 1967 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-3391

This paper is concerned with the approximate solutions of mixed boundary value problems for Poisson's and Laplace's equations for regions in a general n-dimensional Euclidean space. Several finite difference schemes are considered and the rates of convergence of the approximate solutions of these analogs to the actual solutions are investigated. The effects, on the order of convergence, of isolated singularities in the data, are examined and the results are applied to solve the exterior problem. The question of convergence with minimal regularity assumptions for the Laplace's equation is also studied, where it is shown, e.g., that if the solution has Hölder continuous derivatives on the boundary, then we have convergence of order $O(h^{\lambda})$, where λ is the Hölder exponent. Finally, for n = 2, a discussion of a new second order approximation to the normal derivative, resulting in an $O(h^2)$ convergence is included together with some numerical results. Dissert. Abstr.

N69-13994 Iowa State Univ. of Science and Technology, Ames.
A NUMERICAL METHOD OF CHARACTERISTICS FOR SOLVING HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS
David Lenz Simpson (Ph.D. Thesis) 1967 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-2862

The dissertation establishes a numerical algorithm for the solution of quasi-linear hyperbolic second order partial differential equations by the method of characteristics. The algorithm is a predictor-corrector type of order three. The solvability of the systems arising from the application of the predictor and the corrector is dealt with as is the truncation error involved in each. The stability of the corrector and the instability of the predictor is also proved. The method is not self-starting and therefore a starting technique and ideas for changing step-size are discussed. Several examples of the algorithm applied to specific problems are shown and the results tabulated. Dissert. Abstr.

N69-13999# Atomic Energy Establishment, Winfrith (England).
ON THE REDUCTION OF COMPLEXITY OF LINEAR DYNAMICAL MODELS
D. Mitre 1967 127 p refs
(AEEW-R-520) Copyright. Avail: Issuing Activity

Given a linear time invariant dynamical system X with n state variables x_i governed by the differential equations $X : d/dt \underline{x} = \underline{A}\,\underline{x} + \underline{B}\,\underline{u}(t)$ $\underline{m}(t) = D^1\underline{x}(t)$, the problem is to synthesize a similar system X_r with (n−m) state variables, whose linear outputs are a good approximation to those of X. Two principal cases of inputs $u_i(t)$ $(1 \leq i \leq p)$ are considered: weighted Dirac impulses (δ-functions), and white Gaussian noise. Four different methods of reduction corresponding to different levels of sophistication and computing effort required are given. A method of deriving the optimum dynamical system whose response for any input disturbance is identical to the projection, onto a subspace of specified dimension, of the response is given, together with the solution to the stochastic problem. Two simple examples are considered to demonstrate the numerical procedures. Author

N69-14002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN PROGRAM FOR SPLINE FIT CURVE
Theodore Katsanis Washington Dec. 1968 12 p refs
(NASA-TM-X-1707) Avail: CFSTI CSCL 12A

The spline fit curve is a convenient method for fitting a curve through a given set of points. This report describes a FORTRAN IV computer program which will calculate the spline fit curve, with function values, first and second derivatives, and curvature at any desired interpolated points. Author

N69-14013*# Maryland Univ., College Park. Computer Science Center.
NUMERICAL SOLUTION OF FREDHOLM INTEGRAL EQUATION OF THE FIRST KIND
Abraham A. Tal Jan. 1967 37 p refs
(Grant NsG-398)
(NASA-CR-98595; SR-1) Avail: CFSTI CSCL 12A

The equation $\int_0^1 K(s,t) \times (t)\, dt = y(s)$, with K(s,t) continuous in both variables, has a solution for only those functions y(s) which have a Fourier expansion $\Sigma(\eta_i \phi_i$ such that $\Sigma(\eta_i/\lambda_i)^2 < \infty$. Approximate solutions obtained by finite difference discretization are highly oscillatory even when the order of the corresponding matrix is only moderately large. It is proved that the method of steepest descent does provide smooth approximations. A number of numerical examples are given. In the applications, it occurs sometimes that the righthand side is known at a small number of points only. For this case a choice is proposed for the solution and a relationship is established between this solution and that of the integral equation. Author

N69-14045 New York Univ., N. Y.
ON THE EXISTENCE OF SOLUTIONS TO CERTAIN BOUNDARY VALUE PROBLEMS FOR NON-ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS
Ralph Knopf (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-6077

In this paper we consider partial differential equations on the interior of an N+1 dimensional spherical shell of arbitrary thickness. Dirichlet data is assumed to be given on the two bounding spheres. We prove the existence of solutions to this problem for certain non-elliptic partial differential equations. First, the problem is rephrased in terms of spherical coordinates. Initially, we assume that the resulting equations are linear. Hilbert space methods paralleling those of L. Nirenberg [1] are then used to prove the existence of solutions. Using estimates due to M. Schecter [2] the regularity conditions on these equations are relaxed. Finally, an adaptation of a theorem by J. Schwartz [3] is used to extend these results to non-linear equations. Dissert. Abstr.

N69-14053 Ohio State Univ., Columbus.
LIMIT THEOREMS FOR NON-NEGATIVE MATRICES
Lawrence Andrew Klimko (Ph.D. Thesis) 1967 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-3006

A new approach to the ergodic theory of positive matrices developed by the method of Banach limits. Dissert. Abstr.

N69-14054 Maryland Univ., College Park.
INEQUALITIES FOR EIGENVALUES CONNECTED WITH VARIATIONAL PRINCIPLES
William Stenger (Ph.D. Thesis) 1967 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-3388

This paper deals with certain fundamental inequalities in the variational theory of eigenvalues. The new maximum-minimum theory of eigenvalues is extended to a class of unbounded operators and necessary and sufficient conditions are given for equality in several inequalities for the eigenvalues of both bounded and unbounded operators. Dissert. Abstr.

N69-14084 Duke Univ., Durham, N. C.
EXISTENCE, EXTENSION, AND CHARACTERIZATION OF RING AND FIELD TOPOLOGIES
John Oscar Kiltinen (Ph.D. Thesis) 1967 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-3432

The general method developed is based upon a technique to show that there are unusual ring topologies on the integers. The

technique involves building up each set V_n, n = 0, 1, 2, ... in a countable basic system of neighborhoods of zero by an inductive procedure. At the nth stage in the construction, zero is introduced and one element, a_n, from the ring, and its negative into the set V_n. With regard to existence of topologies, several theorems are given which show that certain types of rings will admit nondiscrete, Hausdorff inductive ring topologies. One of these asserts that any integral domain which is a union of countably many subsets of smaller cardinality admits uncountably many such topologies. Another asserts that there are such topologies on any commutative ring A with identity which is the union of a countable chain $(A_n)_{n\geq 1}$ of subrings such that there are elements of A of arbitrarily high algebraic degree over each of the subrings A_n. Dissert. Abstr.

N69-14107 Princeton Univ., N. J.
ON THE STRUCTURE OF THE COHOMOLOGY OF H-SPACES
Alexander Zabrodsky (Ph.D. Thesis) 1967 47 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-2531

The main problems studied in this thesis concern with the Hopf algebra structure of the cohomology mod p, p odd, of a homotopy associative H-space with commutative homology ring. Some "implications" theorems are derived and it is proved that if the cohomology of a homotopy associative H-space is primitively generated then it is free and that if the cohomology of such a space is finite dimensional then it is the exterior algebra on odd dimensional generators, provided its homology ring is commutative. Dissert. Abstr.

N69-14108 Washington Univ., Seattle.
ON MAPS WHICH PRESERVE ALMOST PERIODIC FUNCTIONS
Melvin Carl Tews (Ph.D. Thesis) 1967 44 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-3883

Let G and H be locally compact abelian groups. A continuous function f mapping G into H is said to be a group-valued almost periodic function if for each neighborhood V of the identity of H there is a finite set, $|g_1,...g_n|$, in G such that for each x in G there is an i, $1 \leq i \leq n$, such that $f(g_i+g) - F(x+g)$ is in V for each g in G. We denote the set of such functions by AP(G,H). The main results of this thesis are: (1) If G is a locally compact group, H is a locally compact abelian group and $\rho : G \rightarrow H$ preserves almost periodic functions, then ρ is continuous. (2) Let G and H be locally compact abelian groups. Then $\rho : G \rightarrow H$ with $\rho(G)$ precompact preserves almost periodic functions if and only if ρ is in AP(G,H). (3) Let G and H be locally compact abelian groups and let G be connected. Then $\rho : G \rightarrow H$ preserves almost periodic functions if and only if $\rho = h + p$ where p belongs to AP(G,H) and h is a continuous homomorphism from G to the connected component of the identity of H. Dissert. Abstr.

N69-14119# Ohio State Univ. Research Foundation, Columbus.
MEASURE THEORETICAL FOUNDATIONS OF SURFACE AREA THEORY, PART 2 Final Report, 13 Aug. 1965–30 Sep. 1968
Robert House 26 Sep. 1968 9 p refs
(Grant DA-ARO(D)-31-124-G589)
(AD-677408; AROD-1685.28-M; REPT-4) Avail: CFSTI CSCL 9/2

Four computer programs and references to the underlying mathematical theory are described. The four programs accept as input, specifications for two-level logical networks. Subject to computer limitations of execution time or storage, the program will accept any number of inputs and outputs with or without dont cares and report in a convenient form those sums-of-products realizations which are optimal under various optimality criteria. The fourth program in the sequence may be used alone to solve certain classes of linear integer programming problems. Extensions of the work are cited. Author (TAB)

N69-14190# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
IMPLEMENTATION OF E. BALAS' ALGORITHM
Michel Truchon Aug. 1968 32 p refs
(Contract Nonr-760(24))
(AD-677824; RR-143) Avail: CFSTI CSCL 12/2

The report describes and explains how to use a computer program to solve decomposed linear problems. Author (TAB)

N69-14206*# National Aeronautics and Space Administration, Washington, D. C.
THE NETS OF REGULAR AND SEMIREGULAR POLYHEDRONS AND CORRESPONDING CORRELATIVE NETS [SULLE RETI DI POLIEDRI REGOLARI E SEMIREGOLARI E SULLE CORRISPONDENTI RETI CORRELATIVE]
A. Andreini Nov. 1968 63 p refs Transl. into ENGLISH from Soc. Ital. Delle Sci. Mem. Di Math. E Di Fis., ser. 3, v. 14, 1907 p 75–129
(NASA-TT-F-11994) Avail: CFSTI CSCL 12A

The author assumes the existence of regular and semi-regular polyhedra and examines in what ways some of these figures can fill space continuously. Based on analogy with plane geometry, the author proceeds with a study of Platonic bodies and Archimedes polyhedra. He finds regular polygons which multiply provide right angles by totalling their vertex angles. In all there are ten plane nets. Based on these, two properties are established for polyhedral nets: the sum of all the dihedrals of the polyhedra, which are around one net edge, is equal to 4 straight dihedrals, and the sum of all solid angles around one vertex of a net equals 8 tri-rectangular pyramids. The numerical values of the dihedral and solid angles of the various regular and semiregular polyhedra are then determined. By following a correlative concept by which solid relations can be deduced from plane relationships, it is established that nets of ordinary space can be regarded as bodies of an infinite number of polyhedra of four-dimensional space. Author

N69-14208 California Univ., Los Angeles.
A GENERALIZATION OF NEWTON'S METHOD WITH AN APPLICATION TO THE EULER–LAGRANGE EQUATION
Richard Alfred Tapia (Ph.D. Thesis) 1967 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-6139

A procedure is presented for approximating the zeros of a nonlinear operator P from a Banach space X to a Banach space Y. This procedure is general enough to include the generalized Euler–Lagrange equation. The procedure presented is called the weak Newton method and is a generalization of L. V. Kantorovich's Newton's method. A variation of the weak Newton method, which is usually easier to use, is also presented. It is shown that both the weak Newton and this variation converge quadratically and can be used to solve the Euler–Lagrange equations. Dissert. Abstr.

N69-14222 Indiana Univ., Bloomington.
ON RADICAL RINGS
Christian Wilhelm Kroener (Ph.D. Thesis) 1967 43 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-2313

In the first chapter properties of radical rings are discussed in relation to semiradical rings and nil rings. An example is given of a finitely generated radical algebra over a principal ideal domain which is not nil. Then the corresponding polynomial rings are studied: polynomial rings over semiradical rings are semiradical rings, polynomial rings over commutative radical rings are either nil or semisimple. It is proved that the (Jacobson) radical $J(R[t])$ of

a polynomial ring over an arbitrary ring R is a nil ideal of R[t]. In Chapter III left quasi quotient rings are defined with respect to quasi multiplication analogous to left quotient rings with respect to ordinary multiplication. The definitions of quasi ideal and direct sum of quasi ideals is given. The following theorem similar to the first Goldic theorem is proved: A ring R has a left quasi quotient ring Q which is a radical ring if and only if (1) every non-empty left quasi ideal of R contains a semiradical element and (2) R does not contain any infinite direct sums of left quasi ideals. Dissert. Abstr.

N69-14230# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
A MODIFIED QUASILINEARIZATION TECHNIQUE FOR THE SOLUTION OF BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS
Charles A. Baird, Jr. Jul. 1968 21 p refs
(CT-22) Avail: Issuing Activity

A new quasilinearization algorithm is presented which essentially eliminates the necessity for computer storage. The representation theorem for the standard quasilinearization procedure is reformulated in terms of the initial value of the solution to a final value problem, leading to a modification of the successive approximations. Several theorems, establishing the convergence properties, which like the original procedure are both quadratic and monotonic, are proven. Finally, the modified approximation scheme is illustrated in several examples. Author

N69-14233# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
CORDUNEANU–POPOV APPROACH TO THE STABILITY OF NONLINEAR TIME-VARYING SYSTEMS
James H. Taylor and Kumpati S. Narendra Feb. 1968 24 p refs
(CT-20) Avail: Issuing Activity

Previous extensions of the stability criterion of Popov for systems with a linear time-invariant plant G(s) followed by a nonlinear time-varying gain k(t)f(·) entailed the definition of nonlinearity classes $[f(\cdot) \in N]$ and corresponding frequency domain multipliers $Z_N(s)$. In this report, the point-by-point requirement is replaced by an integral criterion. Author

N69-14248# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
COMPUTATIONAL STABILITY AND TIME TRUNCATION OF COUPLED NONLINEAR EQUATIONS WITH EXACT SOLUTIONS
F. Baer and T. J. Simons Aug. 1968 46 p refs /*ts* Atmospheric Sci. Paper No. 131
(Grant NSF GA-761)
Avail: Issuing Activity

A general numerical integration formula is presented which generates many of the commonly used one-dimensional finite-difference schemes. A number of these schemes are tested on a simple wave equation; three implicit and three explicit are chosen for further analysis with a nonlinear set of equations with known solutions. A seventh method of the implicit type not requiring iteration is also tested. A transformation is developed which allows the removal of linear terms from the nonlinear equations, thereby avoiding truncation of the linear terms. The results show that energy components may have large errors when the total energy shows essentially none, and phase errors may be quite serious without indication from linear analysis. By treating the uncoupled linear terms exactly (no truncation), significant improvement in the numerical solutions ensues. Great care must be taken in interpreting the linear stability criterion; to avoid significant truncation errors the critical truncation increment should be considerably reduced. Author

N69-14252*# Ohio State Univ. Research Foundation, Columbus. Dept. of Mathematics.
NONPARAMETRIC RANKING AND SELECTION PROCEDURES Final Report, 1 Jul. 1967–30 Sep. 1968
M. Haseeb Rizvi 30 Sep. 1968 5 p refs
(Grant NGR-36-008-040; RF Proj.-2241)
(NASA-CR-98673) Avail: CFSTI CSCL 12A

Summary data are presented on research efforts to develop nonparametric methodology in the area of statistical ranking and selection procedures. It is reported: (1) A nonparametric procedure based on order statistics was proposed as a solution to the problem of selecting a subset of several populations which, with high probability, includes all populations that are better than a control population. Here, a population is considered to be better than the control if it has a smaller proportion of deficient items. (2) In considering certain multiple-decision procedures based on rank sums which were proposed for analyzing data in a one-way layout, two problems are examined; select the indices of the t largest θ-value, and select a subset containing the index of the largest θ-value. M.G.J.

N69-14273*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYNOMIAL SMOOTHING FORMULAS AND DERIVATIVE FORMULAS FOR ONE OR TWO INDEPENDENT VARIABLES
A. J. Semtner 15 Nov. 1968 72 p refs
(Contract NAS7-100)
(NASA-CR-98657; JPL-TR-32-1312) Avail: CFSTI CSCL 12A

A systematic procedure is described for the determination of coefficients in linear smoothing formulas and related derivative estimation formulas, and coefficients are tabulated for a selection of commonly useful formulas of this type. Author

N69-14310 Kansas Univ., Lawrence.
ON THE CONTACT OF CARTAN VARIETIES WITH ALGEBRAIC HYPERSURFACES IN n-DIMENSIONAL PROJECTIVE SPACE
William Dale Maness (Ph.D. Thesis) 1967 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-6927

An analytic variety which sustains asymptotic parametric curves is known as a Cartan variety. The tensor method applied to the projective differential geometry of surfaces is used in this study of Cartan varieties in n-space to obtain generalizations of familiar properties of ordinary projective space. The number of necessary conditions for an algebraic hypersurface to have p^{th} order contact with an analytic variety of m dimensions in n-space and the number of coefficients of an algebraic hypersurface of degree k are given. This generalizes the well known expression $(p+1)(p+2)/2$ for the number of conditions that must hold in order that an algebraic surface have contact of order p with an analytic surface. A generalization of Green's "relation R" is given for a linear (n-2)-space L and a line χ. This generalized relation is also called the relation R. The power series expansion in local non-homogeneous coordinates for the equation of an (n-1)-dimensional variety in n-space is obtained and simplified by choosing a suitable reference frame. Dissert. Abstr.

N69-14323# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
SUMMARY OF RECENT WORK ON VARIABLES ACCEPTANCE SAMPLING WITH EMPHASIS ON NON-NORMALITY
Donald B. Owen 2 Sep. 1968 14 p refs
(Contract N00014-68-A-0515)
(AD-677045; TR-1) Avail: CFSTI CSCL 12/1

Acceptance sampling plans based on the normal distribution have been available since 1955 and before. Yet reports of potential users indicate a general lack of enthusiasm for their application. There

is the uncertainty of the assumption of the normal distribution, but the difficulties users have encountered are attributable more to the translation from the standardized deviate to proportion defective than with the probabilities involved. Some possible ways of adjusting for this are discussed. Sampling plans for truncated life tests based on the exponential, normal, lognormal, gamma, Weibull, etc., distributions are also available, as are distribution-free life test plans based on increasing or decreasing failure rate distributions. These are extremely useful and further extensions of these ideas are in the offing. For the normal distribution, plans have been devised which control each tail of the distribution to separate levels. These plans are useful in the very common situation where defectiveness measured on the high side has one kind of effect while defectiveness on the low side has another kind of effect. Again questions on the appropriateness of the normality assumption are raised. A discussion of various ways of meeting this assumption is given. Author (TAB)

N69-14355# California Univ., Livermore. Lawrence Radiation Lab.
DECONVOLUTION OF SPECTRAL-DEPENDENT MEASUREMENTS
H. P. Richter 12 Jun. 1968 8 p refs
(Contract W-7405-ENG-48)
(UCRL-50472) Avail: CFSTI

A method for determining signal functions by deconvoluting a series of physical measurements when apparatus response and output functions are known is presented. The presentation includes the case in which the output function consists of a single value as well as the case in which the response function has several discontinuities. Both of these cases normally are not found in the literature. Two approaches to the deconvolution method are described and the advantages of each are stated. One of these approaches uses analytical integration to obtain a system of linear equations. The other results in a system of nonlinear equations applicable to more difficult numerical situations. Although the described deconvolution method has been applied specifically to a series of spectral measurements, the discussion indicates the usefulness of the method in solving other physical and mathematical problems. Author (NSA)

N69-14389# Institute for Advanced Study, Princeton, N. J.
ADVANCED MATHEMATICAL RESEARCH Final Report
Atle Selberg Sep. 1968 9 p
(Grant AF-AFOSR-359-66)
(AD-676999; AFOSR-68-2099) Avail: CFSTI CSCL 12/1

The unifying theme in the Advanced Mathematical Research supported by the grant during the past year is analysis, as it has been in past years. During this year some 16 manuscripts were submitted by the mathematicians supported by the grant and some more are in preparation. The titles of these manuscripts indicate, and the research summaries in the Addendum attached to this report give further evidence of the considerable diversity of the research undertaken. While some of this work belongs to the central or even classical parts of analysis (Kannai, Goldstein, Ryff), most of it deals with areas where analysis interacts with other disciplines. Some of these contact areas are rather new, as exemplified by the work of Atiyah combining algebraic topology with the study of elliptic operators or, in another direction, by the work of P. Sally, where new connections with number theory appear. Author (TAB)

N69-14391# Miami Univ., Coral Gables, Fla. Dept. of Mathematics.
INTERPOLATION WITH POLYNOMIALS TO BOUNDARY VALUES Final Scientific Report, 1 Aug. 1966–31 Jul. 1968
J. H. Curtiss Sep. 1968 21 p refs
(Grant AF-AFOSR-356-66)
(AD-677603; AFOSR-68-2406) Avail: CFSTI CSCL 12/1

The paper is the Final Scientific Report for research under the above titled grant. The central theme of the project supported by the grant is research into the theory and practicality of solving boundary value problems in applied mathematics by what Collatz calls the method of collocation. The method consists in taking functions of a simple type (here polynomials) which satisfy a given underlying partial differential equation, and forcing them to coincide with the boundary data at various points chosen on the boundary. The central question for mathematical research is as follows: By properly spacing the interpolation points and by indefinitely increasing their number, is it possible to make the corresponding sequence of simple functions approach the solution of the boundary value problem throughout the region enclosed by that boundary. The type of boundary value problem on which this project is focused is the Dirichlet Problem. Author (TAB)

N69-14411 Purdue Univ., Lafayette, Ind.
AN INVESTIGATION OF THE TECHNIQUE OF STATISTICAL LINEARIZATION
Jack William Hugus (Ph.D. Thesis) 1967 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-6313

The statistical linearizations of various types of stochastic differential equations containing odd nonlinearities which are functions of the displacement only are examined. Both stochastic forcing and stochastic coefficient systems of first and second order are considered. The class of stationary systems for which statistical linearization is known to yield good moment approximations is extended to include first order white noise forced-white noise coefficient systems. It is shown that the statistical linearizations of unforced first order white and nonwhite noise coefficient systems are almost surely Lyapunov stable for all parameter values, even those for which the nonlinear systems are almost surely unstable. A computer study of a second order unforced white noise coefficient system with a cubic nonlinearity indicates that an analogous statement is valid for second order systems. Dissert. Abstr.

N69-14415# Oak Ridge National Lab., Tenn. Mathematics Div.
SOME TOPICS IN NUMERICAL ANALYSIS
G. W. Stewart, III Sep. 1968 74 p refs
(Contract W-7405-ENG-26)
(ORNL-4303) Avail: CFSTI

Two disjoint topics in numerical analysis are considered: Lehmer's method for solving algebraic equations and an acceleration procedure for the orthogonal iteration for the eigenvectors of a Hermitian matrix. Lehmer's method for finding a zero of a polynomial is a procedure for searching the complex plane in such a way that a zero is isolated in a sequence of disks of decreasing radii. Modifications of the method that improve its numerical stability are given. The asymptotic behavior of the method in the presence of rounding error is examined. The orthogonal iteration for finding invariant subspaces is a variant of Bauer's treppen-iteration. For a Hermitian matrix, it yields a set of dominant eigenvectors. However, the method converges slowly to eigenvectors corresponding to poorly separated eigenvalues. An acceleration procedure is proposed which yields a set of refined eigenvalues and eigenvectors. Error bounds for the refined eigenvalues and eigenvectors are derived. Author (NSA)

N69-14427# Oak Ridge National Lab., Tenn.
THEORY OF AN INITIAL-BOUNDARY VALUE PROBLEM OCCURRING IN THE STUDY OF FISSION PRODUCT DEPOSITION
Paul Nelson, Jr. and T. S. Kress Sep. 1968 30 p refs
(Contract W-7405-ENG-26)
(ORNL-4277) Avail: CFSTI

A theoretical study was made of an initial-boundary value problem for a semilinear hyperbolic system of two partial differential equations in two unknowns depending on one spatial variable x

and the time t. The nondimensional equations were developed to describe deposition of fission products from a carrier stream onto an isothermal conduit surface with a saturating adsorption-desorption reaction. However they may have general application to convective systems in which a first order chemical reaction at the surface is kinetically important. Author (NSA)

N69-14474# Illinois Univ., Urbana. Coordinated Science Lab.
RESEARCH IN SYSTEM THEORY Final Scientific Report, 1 Jul. 1967-30 Jun. 1968
Jose B. Cruz, Jr. Oct. 1968 10 p refs
(Grant AF-AFOSR-931-67)
(AD-677612; AFOSR-68-2405) Avail: CFSTI CSCL 12/1

The project was concerned with research on new methods of control system analysis and design. In particular, results were obtained on efficient generation of sensitivity functions, algebraic optimization in adaptive control, singular perturbation techniques, design of approximately optimal systems in the presence of uncertainties, and design of large scale systems. Author (TAB)

N69-14476*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REGRESSION ANALYSIS PROCEDURES FOR THE EVALUATION OF TRACKING SYSTEM MEASUREMENT ERRORS
Bobby G. Junkin Washington Dec. 1968 141 p refs
(NASA-TN-D-4826) Avail: CFSTI CSCL 17I

A regression analysis method for Tracking System Error Model Studies (TEMS) is presented for evaluating systematic errors in measurements obtained from various tracking systems. The mathematical procedures include a rigorous least squares adjustment of error model parameters with constraints, using a priori values for these parameters and their variances. Truncated tracker error models for representing the systematic errors are established using the TEMS method in conjunction with a stepwise regression procedure. This procedure involves examining at every step the variables incorporated in the error model in previous steps. A specific variable is deleted from or entered into the model by using the Gaussian Elimination Method for solving the linear system of normal equations in the regression. Although C-band radar error models are used, the procedures can be adapted to other types of tracking systems. Results from application to the Apollo-Saturn 501 (AS-501) flight test data are presented and indicate generally acceptable truncated C-band radar error models. Author

N69-14490# Parke Mathematical Labs., Inc., Carlisle, Mass.
STUDY OF THE MATHEMATICAL FOUNDATIONS OF THE MEDICAL AXIS TRANSFORMATION Final Report, Nov. 1965-Aug. 1968
Aug. 1968 50 p refs
(Contract AF 19(628)-5711)
(AD-677725; ARCRL-68-0498) Avail: CFSTI CSCL 12/1

Part One of this report is a brief summary of the research performed under the contract. Part Two presents in 8 sections a study of the skeletal graph G of a silhouette F and some of the relations between the properties of G and the shape of F. Author (TAB)

N69-14569# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NORMS AND INEQUALITIES FOR CONDITION NUMBERS. II
Albert W. Marshall and Ingram Olkin Sep. 1968 13 p refs *Its* Math. Note 571
(AD-677107; D1-82-0750) Avail: Issuing Activity CSCL 12/1

The condition number c sub phi of a nonsingular matrix A is defined by c sub phi (A) = phi (A) phi (A superscript -1) where ordinarily phi is a norm. It was shown by J. D. Riley that if A is positive definite, c sub phi (A + kI) = or < c sub phi (A) when k > 0 and phi squared (A) is the maximum eigenvalue of AA* or phi squared (A) = Tr AA*. In this paper it is shown more generally that c sub phi (A + B) = or < c sub phi (B) when phi satisfies phi (U) = or < phi (V) if V-U is positive definite and when A,B are positive definite satisfying c sub phi (A) = or < c sub phi (B). Some related inequalities are also obtained. As suggested by Riley, these results may be of practical use in solving a system Ax = d of linear equations when A is positive definite but ill-conditioned. Author (TAB)

N69-14583# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME APPLICATIONS OF HIGHEST-ORDER SEMI-INVARIANTS TO THE THEORY OF STATIONARY RANDOM PROCESSES
V. P. Leonov 29 Nov. 1967 65 p refs Transl. into ENGLISH of the book "Nekotoryye Primeneniya Starshikh Semiinvariantov k Teorii Statsionarnykh Sluchaynykh Protsessov"
(AD-677239; FTD-HT-23-1279-67) Avail: CFSTI CSCL 12/1

Contents: Some remarks on the moment problem in an infinite-dimensional space; Application of semi-invariants to the Ergodic Theory of stationary processes; Semi-invariant conditions for applicability of the central limit theorem to random processes; The Central Limit Theorem for Ergodic endomorphisms of compact commutative groups. TAB

N69-14597# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
CANONICAL TRANSFORMATIONS DEPENDING ON A SMALL PARAMETER
Andre Deprit Sep. 1968 36 p refs *Its* Math. Note 574
(AD-677109; D1-82-0755) Avail: Issuing Activity CSCL 12/1

The concept of a Lie series is enlarged to encompass the cases where the generating function itself depends explicitly on the small parameter. Lie transforms define naturally a class of canonical mappings in the form of power series in the small parameter. The formalism generates nonconservative as well as conservative transformations. Perturbation theories based on it offer three substantial advantages: they yield the transformation of state variables in an explicit form; its inverse in an explicit form results basically from elementary quadratures; in a function of the original variables, substitution of the new variables consists simply of an iterative procedure involving only explicit chains of Poisson brackets. Author (TAB)

N69-14601# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
IDENTIFICATION OF PARAMETERS BY THE METHOD OF QUASILINEARIZATION
Duane B. Larson and John T. Fleck 14 May 1968 23 p refs
(CAL-164) Avail: Issuing Activity

The method of quasilinearization is a combination of the properties of the high speed digital computer with established linearization techniques in such a fashion that it can be used as a method of identifying parameters. The mathematics used in the program is developed in detail and an example is given of its use. Essentially the method is an efficient device of searching for unknown parameters existing in a set of algebraic or differential equations. The mathematical concepts are historical but the combination of historical mathematics with the high speed digital computer yields new and useful results. Author

N69-14679# RAND Corp., Santa Monica, Calif.
NEW CONDITIONS FOR CENTRAL LIMIT THEOREMS
Percy A. Pierre Oct. 1968 7 p refs
(AD-677200; P-3953) Avail: CFSTI CSCL 12/1

A general formulation of the central limit problem for sums of independent random variables is given. By assuming the existence of fourth-order moments, one is able to prove new necessary and sufficient conditions for both Normal and Poisson convergence which involve only moments. The proof of the theorem makes use of a characterization of the Normal distribution among infinitely divisible laws which was perhaps first recognized by Borges and later independently by the author. TAB

N69-14695# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
NEMATORTS: DESIGN CURVES FOR WHICH CURVATURE-SQUARED TIMES TORSION IS A CONSTANT AND CURVATURE AND TORSION ARE PERIODIC FUNCTIONS OF ARC LENGTH
G. R. Stoodley Nov. 1968 45 p ref
(RE-350) Avail: Issuing Activity

To provide the user of a computer-aided design system with an adequate file of analytical tools, a search was undertaken to find new types of design curves. In the search, a class of curves with several unusual properties was found. These curves are solutions to a variational problem for which we can obtain the relevant Euler differential equations. All the curves have the property $\kappa^2\tau$ = constant, where κ is the curvature and τ is the torsion of the curve. All of these curves except one have the property that κ and τ are periodic functions of arc length. Special solutions in the considered class are circles, helices, and straight lines; other solutions resemble prolate cycloids, lemniscates, and strophoids. Still others are very nearly helices; we call these near-helices. All the possible solutions obtainable we classify under the name nematorts. Although the curves are well-behaved, their use is restricted because of the extensive mathematical procedures necessary to generate them. Author

N69-14708 Purdue Univ., Lafayette, Ind.
ON GENERALIZATIONS OF ADAPTIVE ALGORITHMS AND APPLICATION OF THE FUZZY SETS CONCEPT TO PATTERN CLASSIFICATION
William Go Wee (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-6377

There are essentially three main investigations undertaken in this thesis: (1) The application of fuzzy sets concept to generate a set of discriminant functions for two pattern classes. (2) Generalizations of the adaptive procedures for the discriminant functions needed in (1). (3) The application of a fuzzy automation learning model to pattern classification problem. With the application of the fuzzy sets concept, an iterative procedure for learing the equi-membership surfaces and for generating a set of discriminant functions for two pattern classes is given. Aside from being able to classify disjoint pattern classes, the proposed procedure is specially designed to classify highly joint and scattered pattern classes. The procedure primarily consists of automatic generation of transformation units and equi-membership surfaces. Dissert. Abstr.

N69-14777# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).
STUDY OF THE OPTIMAL DIRECTION OF COMMUTATIONS IN THE CONTENSOU-PONTRYAGIN THEORY. APPLICATION TO THE CASE OF TIME-FREE TRANSFERS BETWEEN ELLIPTIC ORBITS [ETUDE DU SENS OPTIMAL DES COMMUTATIONS DANS LA THEORIE DE CONTENSOU-PONTRYAGIN. APPLICATION AU CAS DES TRANSFERTS DE DUREE INDIFFERENTE ENTRE ORBITES ELLIPTIQUES]
Christian Marchal 1968 30 p refs In FRENCH; ENGLISH summary Presented at the 2nd Intern. Colloq. on the Optimization Methods, Akademgorodok, U.S.S.R., 20–26 Jun. 1968 Submitted for publication
(ONERA-TP-589) Avail: CFSTI

Using optimization theories can be done without the notions of 'control' and of 'domain of control' but only with those of 'maneuverability domain' and of 'adjoint vector'. In these conditions it is easy to show that the commutations, that is to say the discontinuities of the optimal trajectories or of their first derivatives are generally in a well determined direction. However there are some limiting cases which lead to singular solutions such as the 'intermediate thrust arcs' of Lawden. Usually these singular solutions are not optimal. The application of these results to the optimal time-free transfers between elliptic orbits leads to a very simple rule of commutation: the commutation always occurs in the direction which reduces the derivative of the mechanical energy (per unit of mass) with respect to the characteristic velocity. There are two limiting cases: the 'limit case of Lawden' and the 'limit case of Contensou'. They lead to singular arcs which are never optimal. A new simple particular case is studied in detail: the transfer between symmetrical orbits with respect to a plane containing the center of mass (the rotations along the orbits being symmetrical). The optimal solutions are of four types: with one horizontal impulse; bi-parabolic; with 3 symmetrical impulses; with two unsymmetrical impulses. The last type is rare and only occurs when the eccentricity of the related symmetrical orbits is greater than $2/\sqrt{3}$ (=0.8165). Author (ESRO)

N69-14782# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).
OPTIMALITY CONDITIONS FOR MANEUVERABILITY DOMAINS WITH SEMI-AFFINE BOUNDARY [CONDITIONS D'OPTIMALITE POUR LES DOMAINES DE MANOEUVRABILITE A FRONTIERE SEMI-AFFINE]
Pierre Contensou 1968 22 p refs In FRENCH; ENGLISH summary Presented at the 2nd Intern. Colloq. on the Optimization Methods, Akademgorodok, U.S.S.R., 20–26 Jun. 1968 Submitted for publication
(ONERA-TP-588) Avail: CFSTI

Necessary conditions of optimality are investigated to complement those deriving from the Maximum Principle, in case of maneuverability domains with semi-affine boundaries, i.e. boundaries having in common, at every point, with their tangent hyper-plane a affine sub-variety of this hyper-plane. The possibility is shown to transform a semi-affine boundary problem into an equivalent problem with wholly affine boundary. Conversely it is shown that a wholly affine problem can be brought back to a restricted semi-affine system, characterized by one less dimension on the variable of state. By expressing the convexity of the maneuverability domain in the case of the restricted domain, the Kelly-Bryson optimality criterium is found. In the case where the restricted system is itself affine, the process can be iterated and a generalisation of this criterium is obtained. Another generalization appears with the combined application of the criterion to each degree of linearity of the boundary. A linear substitution on these parameters leads to the condition that a certain quadratic form be semi-definite negative. The sufficiency of the necessary conditions found is not discussed. Author (ESRO)

N69-14849# RAND Corp., Santa Monica, Calif.
TWO-PARAMETER EXPONENTIAL AND RATIONAL FUNCTIONS FOR LEAST-SQUARE APPROXIMATIONS
M. I. Liechenstein Sep. 1968 136 p refs
(Contract F44620-67-C-0045)
(AD-676974; RM-5707-PR) Avail: CFSTI CSCL 9/4

The report describes a computationally efficient scheme for approximating system characteristics by sums of exponentials or by rational functions. Results are applicable to a broad class of

system optimizations, such as those in network synthesis and radar filter design, and to the understanding of cross-correlation measurements, radioactive decay, gas absorption, and mass spectrograph and ultracentrifuge analysis curves. Author (TAB)

N69-14851# Centre National d'Etudes Spatiales, Paris (France). Div. Mathématiques et Traitement.
NUMERICAL INTEGRATION OF THE ATTITUDE EQUATIONS OF THE EOLE SATELLITE [INTEGRATION NUMERIQUE DES EQUATIONS D'ATTITUDE DU SATELLITE EOLE]
P. Ricard 4 Apr. 1968 33 p refs In FRENCH Presented at the Intern. Colloq. on Satellite Attitude Stabilization, Paris, 8–11 Oct. 1968
(PR/MM8-164/MT) Avail: CFSTI

The Runge-Kutta method is used to numerically integrate the attitude equations of the EOLE satellite. Special precautions are taken to deal with discontinuity of the magnetic moments leading to a cusp on the magnetic hysteresis cycle. This problem is dealt with by changing the pitch of integration. ESRO

N69-14950*# Midwest Research Inst., Kansas City, Mo. Mathematics Branch.
RATIONAL APPROXIMATIONS TO TRICOMI'S ψ FUNCTION Interim Report, 20 Mar.–19 Jun. 1968
Jerry Fields and Jet Wimp Jun. 1968 12 p refs
(Contract NAS9-7641; MRI Proj. 3162-P)
(NASA-CR-92442) Avail: CFSTI CSCL 12A

Closed form rational approximations to the Tricomi ψ function are derived, and rational approximations to the G-function are developed. A corollary is given reiterating the main advantages of the rational approximations. These are: (1) They are explicit as opposed to mini–max rational approximations which, in general, can only be given numerically. (2) They can be computed fairly easily, due to the fact that both numerator and denominator polynomials satisfy the same third order recursion relation. (3) An explicit form for the error is known. M.G.J.

N69-14957# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).
MATHEMATICAL THEORY OF THE BOLTZMANN EQUATION [THEORIE MATHEMATIQUE DE L'EQUATION DE BOLTZMANN]
Jean Pierre Guiraud 1968 17 p refs In FRENCH; ENGLISH summary Presented at the 6th Intern. Symp. on the Dyn. of Rarefied Gases, Cambridge, U.S.A., 22–26 Jul. 1968 Submitted for publication
(ONERA-TP-597) Avail: CFSTI

The existence and the unicity of the solutions of the linear Boltzmann equation are studied. The boundary problem examined corresponds to the movement of a gas enclosed in walls reflecting the molecules according to a very general but regular linear process, excluding in particular specular reflexion. The domain of validity is that of small movements around the complete aerodynamic equilibrium. If Ω is the spatial domain, independent of time, within which the gas is contained, and if H is the Hilbert space (on the functions of molecular speed) introduced by Grad, the existence and unicity are established in the class $L^2(\Omega; H)$. This concerns the stationary movement as well as the non-stationary movement with given initial conditions. Author (ESRO)

N69-14987# RAND Corp., Santa Monica, Calif.
OPTIMIZATION PROBLEMS WITH ONE CONSTRAINT
B. L. Fox and D. M. Landi Oct. 1968 31 p refs
(Contract F44620-67-C-0045)
(AD-676975; RM-5791-PR) Avail: CFSTI CSCL 15/5

One-constraint optimization problems are approached via Lagrange multipliers. This memorandum compares sequential search schemes for generating suitable trial multiplier values, and shows that, in general, the minimax sequential search is bisection. For certain applications, it pays to design search procedures that take advantage of special structure, such as recursively defined functions. An efficient search procedure based on bisection for a multi-item, multi-echelon inventory example is also presented. Author (TAB)

N69-14988# Syracuse Univ., N. Y. Dept. of Electrical Engineering.
EXPONENTIAL FUNCTION SETS IN THE ANALYSIS OF NONLINEAR SYSTEMS
Gerald James Kirwin Griffiss AFB, N. Y. RADC Sep. 1968 97 p refs
(Contract F30602-68-C-0022)
(AD-677029; RADC-TR-68-275) Avail: CFSTI CSCL 12/1

An approximate solution for the response of the system to a transient (i.e., nonperiodic) input signal is proposed. The systems under consideration are single loop control systems having a linear dynamic subsystem in tandem in the loop with a memory-free nonlinear subsystem. An approximating system is devised by replacing each signal with its projection on a subspace of square-integrable functions. The transmission of signals in the subspace through the nonlinear part of the system is expressed by a multidimensional equivalent gain function. Several examples are presented in which the new technique is used to generate approximate solutions when the linear subsystem is of second or third order and the nonlinear subsystem is characterized by a polynomial input-output relation. The approximate response is compared with the solution resulting from a numerical integration of the actual system equations. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N69-14069 Virginia Polytechnic Inst., Blacksburg.
PROBABILITY FORECASTS OF 30-DAY PRECIPITATION
John Wesley Philpot (Ph.D. Thesis) 1968 222 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-5566

The purpose is to provide a 30-day precipitation forecast that is local rather than regional in character, is probabilistic rather than categorical, and has categorical reliability comparable to the official Weather Bureau forecast. The probability forecasting technique includes criteria for determining if the process is applicable at a station, as well as the finite memory predictor (FMP) process for generating probability forecasts. Where the FMP process is applicable, the results over past data indicate that its categorical reliability is generally superior to that of the official forecast, while the estimated distributions have an acceptable degree of accuracy. The process is applicable for an estimated 70% of the stations within the 48 contiguous states of the U.S. A computer program is furnished for producing the probability forecasts. Dissert. Abstr.

N69-14253 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 93, NO. 2: DAILY SURFACE AND 850 MILLIBAR MAPS OF THE NORTHERN HEMISPHERE FOR 1968 [METEOROLOGISCHE ABHANDLUNGEN. BAND 93, HEFT 2: TAEGLISCHE BODEN- UND 850-MB-KARTEN DER NORDHEMISPHAERE IM JAHRE 1968, TEIL 2, VIERTELJAHR, 1 APRIL BIS 30 JUNI 1968] Quarterly Report, 1 Apr.–30 Jun. 1968

Manfred Geb, Richard Scherhag et al 1968 186 p In GERMAN (QR-2) Avail: Issuing Activity

All data are presented on stereographic projection maps, scale 1:75,000,000. K.W.

N69-14300# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE TRANSFORMATION OF A TEMPERATURE FIELD, A HUMIDITY FIELD AND THE TURBULENCE CHARACTERISTICS

Ye. D. Nadezhina 14 Dec. 1967 9 p ref Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 144, 1963 p 196–201

(AD-677133; FTD-HT-23-1072-67) Avail: CFSTI CSCL 4/2

The report examines a method of solving the problem on the transformation of a complex of meteorological elements, including the coefficient of turbulence in an air mass which develops into an underlying surface with essentially new properties. The task is solved by sequential approximations. Through a series of mathematical arguments, the report derives an expression for the first approximation. Some calculations which will make it possible to determine the degree of influence of the turbulence regime change consideration on the transformation of the temperature and humidity fields are given. Boundary conditions are calculated and presented. It is evident from the graphs that the indicated condition doubles the value of fluxes at sufficiently large distances from the edge, where the changes of the turbulence coefficient are at a maximum. Author (TAB)

N69-14468# Atmospheric Research and Development Corp., Kansas City, Mo.

PRELIMINARY ESTIMATES OF THE RATE OF GROWTH OF TALL THUNDERSTORMS

Howard H. Hanks, Jr. and Michael J. Long Sep. 1968 22 p refs

(Contract F19628-68-C-0013)

(AD-677716; AFCRL-68-0412; SR-1) Avail: CFSTI CSCL 4/2

Growth rates of thunderstorms which reach to at least 50,000 feet have been summarized for 15 April 1962 - 15 September 1965 for eight cities in the United States. Hourly increments were used. Growth rates relative to vertical wind shear and stability were estimated for four locations: Kansas City, Little Rock, Oklahoma City, and Amarillo. Preliminary results show that (1) growth rates obtained by hourly increments were much smaller than reported by other investigators using shorter time increments; (2) the maximum frequency of high growth rates was found to correspond with maximum frequency of penetrations of the tropopause both geographically and by time of day; (3) vertical wind shear had only a minor influence upon growth rates; (4) no relationship was found between stability and thunderstorm growth rates. Author (TAB)

N69-14505*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND VELOCITY PROFILES MEASURED BY THE SMOKE-TRAIL METHOD AT THE EASTERN TEST RANGE, 1963

Robert W. Miller, James C. Manning, and Robert M. Henry Washington Dec. 1968 129 p refs

(NASA-TN-D-4880) Avail: CFSTI CSCL 04B

Fifty-four detailed wind velocity profiles measured by the smoke-trail technique at the Eastern Test Range during 1963 are presented. The altitude range covered is from approximately 2 to 22 kilometers and the maximum velocity measured exceeds the 99-percent highest value. The persistence of the wind profile shape, under some conditions, for periods up to 2 hours is demonstrated and illustrations are given of the accuracy of the smoke-trail method. Author

N69-14555# Illinois State Water Survey, Urbana.

SUMMARY OF RADAR-RAINFALL RESEARCH , 1952–1968 Interim Report

G. E. Stout, E. A. Mueller, A. L. Sims, R. Catanzo, and F. A. Huff Ft. Monmouth, N. J. Army Electron. Command Oct. 1968 54 p (Contract DA-28-043-AMC-02071(E))

(AD-677413; ECOM-02071-3; IR-3) Avail: CFSTI CSCL 4/2

A summary of research activities and their highlights during the past sixteen years has been prepared in order to focus on the state of knowledge concerning the measurement of rainfall with 3-cm radar. Much effort has been expended on determining the raindrop size distributions for many climatic areas. In order to evaluate the radar, dense networks of rain gages were employed. The availability of the radar and a dense network of raingages has resulted in numerous applications of these facilities for related studies in hydrometeorology, cloud physics and weather modification experiments. In summary, a well calibrated radar is capable of measuring rainfall which is equivalent to about one gage in 60 square miles, detects severe storms, etc., but its utilization is limited due to lack of instrumentation to properly process the large amount of data that becomes available to the user and to the meteorological variance between storms. Author (TAB)

N69-14578*# National Aeronautics and Space Administration, Washington, D. C.

NATURE OF THE WIND AND TEMPERATURE FIELDS NEAR THE UPPER BOUNDARY OF UNDULATUS CLOUDS [KHARAKTER POLYA VETRA I TEMPERATURY V OKRESTNOSTI VERKHNEY GRANITSY VOLNISTYKH OBLAKOV]

L. A. Pakhomov Dec. 1968 15 p refs Transl. into ENGLISH from the book "Fizika Oblakov" Moscow, Gidrometeoizdat, no. 79, 1967 p 48–60

(NASA-TT-F-11944) Avail: CFSTI CSCL 04B

The results of temperature and wind-velocity measurements at the upper boundary of an undulatus cloud are analyzed. Data on three-component wind velocity changes measured in various flight direction are presented, and an air-circulation scheme in the vertical plane normal to the cloud bank is proposed. Author

N69-14580# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

AN APPLICATION OF SOME STATISTICAL TECHNIQUES TO THE STUDY OF EDDY STRUCTURE

Joshua Z. Holland (Ph.D. Thesis—Washington Univ., Seattle) Sep. 1968 378 p refs

(TID-24585) Avail: CFSTI

A system of computational techniques was developed to detect a variety of structural features in time series of fast-response meteorological data. First and second time derivatives, running variances and covariances representing time-varying high-frequency eddy energy and fluxes, and low-pass total velocity were computed at each filter period. Individual probability density functions and moments for each variable, joint density functions (JDF's) and moments for many pairs of variables, and conditional means of other variables as functions (CMF's) of each pair were computed in each band, and contour charts drawn for JDF's and CMF's. A smoothing function over 9 joint class intervals was used to suppress accidental irregularities, principally in the 1 to 10 min band. Linear and curvilinear dependences, skewness, peakedness, multimodality and other non-normal features were observed. The eddy kinetic energy, measured by the sum of the running variances of the three velocity components, showed a high-probability low-turbulence mode and one or more low-probability high-turbulence modes in most cases. Author (NSA)

N69-14662# Environmental Data Service, Silver Spring, Md.
AN ANNOTATED BIBLIOGRAPHY OF CLIMATIC MAPS OF NORTH VIETNAM
Annie E. Grimes Sep. 1968 51 p
(AD-676915; WB/BM-73) Avail: Issuing Activity CSCL 4/2

The bibliography of the climatic maps includes all available sources in various libraries of the Washington Metropolitan Area with maps of North Vietnam, Indochina and southeast Asia.
Author (TAB)

N69-14663# Colorado State Univ., Fort Collins. Fluid Mechanics Program.
WIND DRAG WITHIN A SIMULATED FOREST CANOPY FIELD
George Hsi and J. H. Nath Aug. 1968 144 p refs
(Contract DA-AMC-28-043-65-G20)
(AD-676869; CER68-69GH-JHN6) Avail: CFSTI CSCL 4/2

The report presents an experimental and analytic study of wind drag within simulated forest canopy fields. The drag coefficients, aerodynamic roughness and wind velocity profiles are studied for various types of forest canopies. Furthermore, a brushy canopy field was studied which simulated the leafy portion of a forest without the tree trunks present. The wind drag force on a single experimental tree was also studied. This information is useful to those who are concerned with diffusion within a canopy in an atmospheric boundary layer. In the course of the study a sheer plate was developed which reliably measures a drag force from 0.1 gram to 2000 grams. The function of this plate was successfully validated by testing it in a turbulent flow over a smooth surface. The drag coefficient of a single model tree, which was the same as those used in the simulated forest canopy fields, was compared with prototype conifers. The work found that a plastic model tree has drag coefficients between those for spruce and Douglas fir trees. The variation of the tree drag coefficient among trees of the same type is concluded by a statistical study on a number of plastic trees which have the same amount of foliage but which are different in the arrangement of the tree branches and the tree leaves.
Author (TAB)

N69-14668# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
AN EXPLORATION OF THE ORIGIN AND PERSISTANCE OF THE BEAUFORT WIND FORCE SCALE
Blair Kinsman Aug. 1968 60 p refs
(Contract Nonr-4010(11))
(AD-677044; TR-39) Avail: CFSTI CSCL 4/2

A discussion of the history and meaning of the original Beaufort wind force scale is presented and compared with a recent version. Some account of the accidents that have kept the Beaufort scale current after 160 years and the comedy of providing wind velocity equivalents is given. It is suggested that perhaps the time has come to return the Beaufort force scale to the seamen from whom it was borrowed.
Author (TAB)

N69-14750# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
A THREE-DIMENSIONAL SPECTRAL PREDICTION EQUATION
T. J. Simons Jul. 1968 31 p refs *Its* Atmospheric Sci. Paper No. 127
(Grant NSF GA-761)
Avail: Issuing Activity

A generalization of the two-dimensional spectral forecast equations is suggested, whereby the atmospheric flow field in horizontal and vertical directions is represented in terms of orthogonal functions, which are eigenfunctions of certain differential operators in the three-dimensional equations. The technique is applied to the quasi-geostrophic potential vorticity equation. The quasi-geostrophic potential vorticity is related to the stream function of the horizontal wind by a three-dimensional Laplacian in which the vertical derivative is modified by the standard static stability of the atmosphere. The orthogonal functions are chosen to be characteristic functions of this quasi-Laplacian operator for a given variation of static stability with height. The resulting spectral form of the potential vorticity equation is very similar to that of the barotropic vorticity equation.
Author

N69-14804# Freie Univ. (West Germany).
DAILY AND MONTHLY NORTHERN HEMISPHERE 5-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1966, PART 2, APRIL-JUNE Quarterly Technical Status Report, Apr.-Jun. 1966
Barbara Kriester, Karin Labitzke, Richard Scherhag, and Karl Sieland 1967 117 p *Its* Meterol. Paper vol. 88, no. 2
(Contract DA-91-591-EUC-4043)
(AD-677392; QTSR-2) Avail: CFSTI CSCL 4/2

The reports are published quarterly and present 5 mb maps, day by day, throughout January 1966 - present. Height and temperature data are plotted on each chart and appropriate contours are drawn. A discussion of the stratospheric circulation for each quarter is included. Each volume also contains mean monthly maps and charts of changes in the means from month to month, for the appropriate months. Tables of mean gridpoint data, plotting models and the distribution of Rocket stations are included.
Author (TAB)

N69-14912# National Weather Records Center, Asheville, N. C.
METEOROLOGICAL ROCKET NETWORK FIRINGS. DATA REPORT, VOLUME 5, NUMBER 2
Mar. 1968 222 p
Avail: SOD $3.00

Wind and temperature measurements from all available meteorological sounding rocket firings are presented, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included.
Author

N69-14965*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SENSING OF METEOROLOGICAL VARIABLES BY LASER PROBE TECHNIQUES Semiannual Report, 1 Feb.-31 Jul. 1968
Giorgio Fiocco 30 Nov. 1968 8 p refs
(Grant NGR-22-009-131)
(NASA-CR-98705) Avail: CFSTI CSCL 04B

A summary of the study of the spectrum of coherent light scattered from a water jet with uniform spherical particles is presented. The conditions required to interpret the observed spectrum in terms of a density correlation function are enumerated. Charts showing results of spectra power density versus frequency are included.
F.O.S.

N69-14984# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
TURBULENT VELOCITY AND SCALAR SPECTRA IN STABLY STRATIFIED FLUIDS
Yih-Ho Pao Oct. 1968 10 p refs Presented at the Symp. on Theoret. Probl. in Turbulence Res., University Park, Pa., 9-13 Sep. 1968
(AD-677585; D1-82-0680) Avail: CFSTI CSCL 4/1

From the complete set of two-point covariance equations for the turbulent velocity and temperature fields, the spherically averaged spectra in stably stratified fluids are deduced for the entire locally homogeneous ranges of wave numbers, including buoyancy, inertial, and viscous subranges. The spectral equations are closed with a similarity hypothesis (Pao, 1965, 1968). The predicted

spectral behavior in the buoyancy subrange can be summarized as follows: (1) the spectra in weakly stable fluids agree in general, although differ in detail, with those predicted by Bolgiano (1959), Monin (1962), Shur (1962), and Lumley (1964), that the velocity spectra are steeper than k to the -5/3 power and the temperature spectra are less steep than k to the -5/3 power; (2) in strongly stable fluids, both the velocity and the temperature spectra are wavy, which resemble certain spectral measurements in high altitude clear air turbulence (Reiter and Burns, 1966; Pinus, Shur and Vinnichenko, 1966; Crooks, Hoblit and Prophet, 1967). Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N69-13918 Auburn Univ., Ala.
SENSITIVITIES OF THE OPTIMAL CONTROL
William Curtis Hines (Ph.D. Thesis) 1967 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-5437

The calculus of variations can be used to determine the optimum control for a system. In many cases, however, it is important to know the sensitivities of this control to changes in certain parameters. This thesis presented a practical way by which these sensitivities can be calculated. The method described has less round-off error and requires less computer time than methods relying upon finite differences. It also does not have associated with it the problem of determining the best size perturbation for any given sensitivity, since no perturbations are used. This method was used to determine the sensitivities of the optimum thrust vector control angle to change in initial conditions and other parameters for a vehicle representing the Saturn V. These sensitivities were compared to the sensitivities produced by the iterative guidance mode. Several guidance schemes which would employ the sensitivities are also presented. Dissert. Abstr.

N69-14249*# Lockheed Missiles and Space Co., Huntsville, Ala.
OPTIMUM RENDEZVOUS GUIDANCE STUDY Interim Report
W. Trautwein and J. Waldvogel Jun. 1968 49 p refs
(Contract NAS8-21146)
(NASA-CR-98137; LMSC/HREC-A791387; HREC/1146-1) Avail: CFSTI CSCL 17G

Work in the area of optimum rendezvous guidance is summarized. A general review is given of a simple guidance scheme for minimum fuel rendezvous with two finite burns between a powered intercepting space vehicle in an arbitrary parking orbit circular a target vehicle in an essentially coplanar circular orbit. Major accomplishments during the reporting period were: (1) Development and computer check-out of a rapidly converging iteration method that is used for optimum flight scheduling before the first burn and for optimum first burn guidance. (2) Extension of the dual phase plane method to long terminal burn times, whereas in its original form application of the method was limited to short burns where the radii of interceptor and target from the earth's center were approximately equal. (3) Development, checkout and first utilization of a digital computer program for simulation of complete rendezvous missions with the present guidance scheme used onboard the interceptor. Author

N69-14263*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
SELF ALIGNMENT TECHNIQUES FOR STRAPDOWN INERTIAL NAVIGATION SYSTEMS WITH AIRCRAFT APPLICATION
Kenneth R. Britting and Thorgeir Palsson Nov. 1968 22 p refs
(Grant NGR-22-009-229; DSR Proj. 70343)
(NASA-CR-98671; RE-33) Avail: CFSTI CSCL 17G

One of the more critical problem areas in the application of strapdown inertial techniques to the navigation of commercial aircraft is that of initial alignment. A two stage self-alignment scheme which appears promising in this regard is explored. The first or coarse alignment stage utilizes the measurement of the gravity and earth rotation vectors to directly compute the transformation matrix relating the body frame to a reference frame. A linearized error analysis is presented. The second fine alignment stage corrects the initial estimate of the transformation by feeding back a computed angular velocity command to the transformation computer. This correction signal is computed by using estimates of the error angles between a known reference frame and the corresponding computed frame. Kalman filtering techniques are used to implement this technique and an error analysis is presented. Author

N69-14332*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SEXTANT SIGHTING MEASUREMENTS FROM ON BOARD THE GEMINI 12 SPACECRAFT
Donald W. Smith and Bedford A. Lampkin Washington Dec. 1968 30 p refs
(NASA-TN-D-4952) Avail: CFSTI CSCL 17G

The capability of a spacecraft navigator to make in-flight navigation measurements from on board the spacecraft using a hand-held sextant has been studied extensively. Tests on board the orbiting Gemini 12 spacecraft were designed to determine the effect of the actual spaceflight environment on navigator performance. The results show that: (1) hand-held sextant measurement performance is excellent providing a standard deviation of measurement error less than 10 arc seconds; (2) spacecraft rotational motion and the actual spacecraft environment had little effect on the navigator performance; and (3) window-induced measurement errors in the Gemini 12 spacecraft were small and predictable. The optical hand-held sextant appears to have application to on-board navigation for future manned space flights. Author

N69-14346*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFRARED HORIZON PROFILES FOR WINTER CONDITIONS FROM PROJECT SCANNER
Ruth I. Whitman, Thomas B. Mc Kee and Richard E. Davis Washington Dec. 1968 127 p refs
(NASA-TN-D-4905) Avail: CFSTI CSCL 17G

Measured horizon radiance profiles in spectral bands of 615 cm^{-1} to 715 cm^{-1} (carbon dioxide) and 315 cm^{-1} to 475 cm^{-1} (rotational water vapor) from the Project Scanner flight of December 10, 1968 are shown. Data cover a latitude range from 13° North to 61° North. Excellent agreement between the measured and independently predicted radiance profiles in the CO_2 band where horizontal temperature gradients are small verifies the analytical technique. When the horizontal temperature gradients are large, the computational model used is inadequate for predicting radiance profiles. Seasonal and latitudinal variations in radiance profiles are shown to be primarily a function of the variations in temperature structures. In the 315 cm^{-1} to 475 cm^{-1} (H_2O) region, mixing ratios of water vapor were deduced at low latitudes from the radiance measurements. Under both summer and winter meteorological conditions, the same trends in the mixing ratio above the tropopause are evident, that is, a region of relatively constant mixing ratio followed by a region of increasing mixing ratio. Author

N69-14382*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SIMULATION STUDIES OF THE SUPERSONIC TRANSPORT IN FUTURE AIR TRAFFIC CONTROL SYSTEMS

Richard H. Sawyer, Norman S. Silsby, and Milton D. Mc Laughlin Washington Dec. 1968 90 p refs
(NASA-TN-D-4944) Avail: CFSTI CSCL 17G

The problems anticipated for the supersonic transport (SST) in operations in simulated Air Traffic Control (ATC) systems were studied in real time by using an SST aircraft flight simulator and the Federal Aviation Administration ATC simulation facilities. Airline crews operated the SST flight simulator, and experienced air-traffic controllers operated at ATC simulation facilities. Design-study configurations of the SST were used in the tests. The test program consisted of departures and arrivals under weather conditions which required operations by FAA Instrument Flight Rules in the New York, Los Angeles, San Francisco, and London terminal areas. For the future ATC system concepts investigated, substantial changes in course (up to nearly 50°) at supersonic speeds were required in many instances on the airway routes and to effect transition to and from the high-altitude track systems. Such changes were detrimental to SST performance and increased the workload for the crew. Further, substantial amounts of maneuver fuel were required for complying with ATC flight-path restrictions and for following indirect routings along the airways and to and from the high-altitude track systems. Author

N69-14399*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MINIMUM THRUST FOR CORRECTING KEPLERIAN ORBITS WITH APPLICATION TO INTERPLANETARY GUIDANCE
Frederick W. Boltz Washington Dec. 1968 69 p refs
(NASA-TN-D-4945) Avail: CFSTI CSCL 22C

The first-order thrust requirements obtained in the analysis are presented in terms of the optimum thrust angle and the minimum derivative of thrust-produced velocity impulse with respect to the particular orbital parameter to be corrected. Minimum thrust requirements are found for correction at a given point along an orbit of the semimajor axis, the eccentricity, and the true anomaly or orientation of the line of apsides (argument of pericenter) within the orbital plane. Minimum thrust requirements are also found for correcting the orbital radius at an arbitrary point and the elapsed flight time to arrive at that point. In addition, thrust requirements are obtained for correction at a given point along an orbit of the elapsed flight time to a second arbitrary point having a fixed value of orbital radius. A general formulation of the thrust requirements for simultaneous correction of any pair of the orbital parameters that define the in-plane motion is presented in terms of the minimum thrust requirements for correction of each of the parameters separately. Author

N69-14812# Société d'Economie et de Mathématique Appliqués, Paris (France).
THE POSSIBLE USES OF SATELLITES FOR AIR TRAFFIC CONTROL
Paris EUROCONTROL Jan. 1968 134 p Prepared jointly with EUROSPACE
Avail: CFSTI

The projects and requirements regarding systems of aeronautical satellites in the U.S.A. and Europe and the economic advantages arising from a reduction in separation standards are presented. Economic aspects of aeronautical satellite systems in general are outlined and an investigation of communication and surveillance satellite systems for air traffic control is made. Author (ESRO)

N69-14854# Academy of Sciences (USSR), Moscow.
RESULTS OF ATTITUDE DETERMINATION FROM ONBOARD MEASUREMENTS [LES RESULTATS DE LA DETERMINATION DE L'ORIENTATION PAR LES DONNEES DES MESURES DE BORD]
V. V. Beletskii, V. V. Goloubkov, E. A. Stepanova, and I. G. Hatskevith 1968 p 43 refs In FRENCH Presented at the CNES intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968

The general method of statistical determination of satellite attitude is recalled. Results gained with the Proton 2 satellite are discussed and their accuracy analyzed. ESRO

N69-14962# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
AERODYNAMIC STABILIZATION OF SATELLITES [LE SYSTEME AERODYNAMIQUE DE LA STABILISATION DES SATELLITES]
V. A. Sarychev 1968 p 6 In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

The system of stabilization includes an aerodynamic stabilizer and a gyroscopic damper. Yaw and roll stability is provided through the two two-degree of freedom gyroscopes whereas pitch stability is provided through aerodynamic drag. ESRO

N69-15018*# IIT Research Inst., Annapolis, Md. Microwave Lab.
EMC AEROSPACE SYSTEMS ANALYSIS Interim Scientific Report
Richard J. Otero and William C. Wanbaugh Nov. 1968 150 p refs
(Contract NAS12-639)
(NASA-CR-86117; X6908-7) Avail: CFSTI CSCL 17G

Potential aerospace electromagnetic compatibility (EMC) problems were examined by determining analysis and data requirements for solving these problems, by comparing these requirements with available analytical tools and data bases, and by recommending research and capability development programs. Several systems proposed for the 1540 and 1660 MHz aeronautical radio navigation segment of L-band were examined to determine analysis and data requirements. Existing EMC analysis, measured, environmental, and equipment characteristics data capabilities are summarized. The capability programs recommended for development are in the area of receiver modelling, space channel characterization, an automated interference analysis tool, and a co-site model for satellites and aircraft. The feasibility of obtaining man-made radio frequency noise at orbital altitudes is considered. Data processing requirements are discussed, including the use of computers for EMC file storage, sorting and retrieval, and for interference computations. The development of NASA EMC/frequency management capability is covered, which includes improvement of existing EMC standards and specifications, information dissemination, education, and design guidance. K.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N69-13986# Oak Ridge National Lab., Tenn.
TARGETS FOR NUCLEAR RESEARCH
E. H. Kobisk *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 426–442 refs Supported by AEC
(See N69-13971 04-24)
Avail: CFSTI

Thin-film accelerator targets, both supported and self-supporting, have been prepared from most of the elements in the Periodic Chart. In addition to fabrication, enhancing the chemical purity of separated isotopes is of major importance, and many techniques have been developed for improving the chemical integrity of research samples through the use of wet chemistry, high-temperature solid reaction chemistry, and chemical vapor deposition. Targets containing sorbed tritium gas for use in neutron generators are also fabricated in the Center. Research and development efforts have been directed toward the preparation of cohesive tritium deposits capable of producing high neutron yields under deuteron bombardment with reproducible results. Many samples of isotopic material in bulk quantity have been prepared (for neutron cross-section determinations and other high energy experiments), and physical forms of enriched materials, such as wires, bars, castings, and sintered disks have been prepared to customer specifications. Author

N69-14056# Argonne National Lab., Ill.
COMPILATION OF ENDF/B DATA FOR MAGNESIUM, TITANIUM, VANADIUM, MOLYBDENUM, AND GADOLINIUM
E. M. Pennington and J. C. Gajniak Mar. 1968 122 p refs
(Contract W-31-109-ENG-38)
(ANL-7387) Avail: CFSTI

The compilation of neutron cross-section data for the materials magnesium, titanium, vanadium, molybdenum, and gadolinium is presented. All the data in the ENDF/B format are listed, and graphs of much of the data are presented. Author (NSA)

N69-14057# Idaho Nuclear Corp., Idaho Falls.
APPLICABILITY OF CHEMICALLY REMOVABLE COATINGS TO REACTOR CONTAINMENT BUILDINGS
B. J. Newby Aug. 1968 34 p refs
(Contract AT(10-1)-1230)
(IN-1170) Avail: CFSTI

Two methods are described for the rapid remote decontamination of coated interiors of reactor containment buildings contaminated with volatile fission products, namely, the use of chemically strippable or chemically corrodible coatings. Both methods are based on the removal of temporary coatings containing the contamination with chemical reagents. Author (NSA)

N69-14123# Idaho Nuclear Corp., Idaho Falls.
THE PHYSICAL PROPERTIES OF NITRATE SOLUTIONS OF EBR-2 FUEL ELEMENTS
L. C. Lewis Aug. 1968 16 p refs
(Contract AT(10-1)-1230)
(IN-1192) Avail: CFSTI

Conductivity, viscosity, and density measurements were made on nitric acid solutions simulating those arising from the electrolytic dissolution of EBR-II nuclear fuel elements. Conductivity measurements were made at 25 and 50°C. Specific gravity measurements were made at 25 and 96°C. Viscosity measurements were made at 25°C. Equations relating viscosity with composition and specific gravity with composition and temperature were derived. The solubility of boric acid in these solutions was also determined. Author (NSA)

N69-14124# Atomic Energy Establishment, Winfrith (England). Development Div.
A COMPUTER PROGRAMME FOR THE SUBCHANNEL ANALYSIS OF THE HYDRAULIC AND BURNOUT CHARACTERISTICS OF ROD CLUSTERS. PART 2: THE EQUATIONS (HAMBO)
R. W. Bowring Jan. 1968 60 p refs
(AEEW-R-582) Avail: CFSTI

HAMBO is a computer code for the steady-state hydraulic analysis of a rod cluster assembly cooled by a boiling fluid, using a subchannel model. The burnout characteristics of the cluster are determined by means of appropriate correlations applied to the subchannels. The physical model and use of the code were described in Part 1; Part 2 continues with the listing of the hydraulic equations and their derivation. The code is written in Fortran for the KDF9, and in Fortran S2 for the IBM 7030 computers. It is also available in Fortran IV for the IBM 7090. NSA

N69-14143# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Aug. 1968
Robert B. Duffield and Stephen Lawroski 26 Sep. 1968 112 p refs
(Contract W-31-109-ENG-38)
(ANL-7487) Avail: CFSTI

Highlights of project activities are summarized for the month of August 1968. Fuel development programs for the LMFBR are described. Operations of the ZPR-3 Assembly 51 and 52 for LMFBR physics developments during August 1968 are described. Loading and startup programs of the ZPPR are presented. Operations for the EBR-2 during August 1968 are described: Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. NSA

N69-14148*# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
THE R.C. 13 IONISATION CHAMBER
J. F. Mackie Jun. 1968 20 p refs
(AERE-R-5800) Avail: CFSTI

The R.C. 13 ionization chamber was developed for use in reactor control and instrumentation for the measurement of thermal-neutron flux. It requires a polarizing voltage of 300 to 600 volts, and will deliver up to 50 μA in fluxes up to 10^{19}n/cm^{2}s at normal temperature and pressure. The small diameter reduces installation, handling, and maintenance problems. The chamber and its characteristics are described, together with experience in use in the DIDO reactor. Author (NSA)

N69-14285 Rensselaer Polytechnic Inst., Troy, N. Y.
REACTOR PHYSICS THEORETICAL
In its Linear Accelerator Proj. 31 Mar. 1968 p 39-62 refs
(See N69-14280 04-24)
Avail: CFSTI

The development of methods for calculating flux spectra in fast reactors continued. The average scattering angle in energy-dependent problems was investigated. Some progress is reported in the determination of time moments of fast neutron slowing down in heavy media; the time moments were used to express the time-dependent neutron energy distribution by an expansion in orthogonal polynomials. The influence of re-entrant holes on space-dependent spectrum measurements was analyzed. An expression for the Doppler-broadened resonance cross section in terms of ψ_n integrals was used to derive the temperature coefficient; the Doppler coefficient in fast reactors was also studied. A model that yields the neutron flux as a function of space, energy, and time in fast pulsed neutron assemblies was developed. NSA

N69-14295# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 18: NEUTRON COUNTING AS AN ANALYTICAL METHOD FOR PLUTONIUM FLUORIDES
William A. Shinn and Martin J. Steindler Apr. 1968 52 p refs
(Contract W-31-109-ENG-38)
(ANL-7402) Avail: CFSTI

Counting of neutrons generated in plutonium fluorides was investigated as a method of quantitatively determining plutonium hexafluoride (PuF_6) as well as plutonium tetrafluoride (PuF_4) alone or mixed with alumina or sodium fluoride (NaF). The plutonium fluorides were obtained by processing simulated, spent reactor fuels by the fluid-bed fluoride-volatility process. With a water-moderated detector employing four proportional counters filled with 10 atm of helium-3, 31.8 counts/(min)(mg PuF_4) were detected, corresponding to about 15% of the neutrons emitted from PuF_4. This sensitivity allows milligram quantities of plutonium fluorides to be determined rapidly and precisely with the accuracy limited by the specific neutron activity of the sample. Neutron activity of a plutonium compound, from the (α,n) reaction with fluorine, varies with the alpha activity of the sample, the type of diluent (alumina or NaF), and the size of particles in the mixtures. Author (NSA)

N69-14304# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.

IN-PILE COMPARISON OF EFFECTIVE THERMAL CONDUCTIVITY OF (PLUTONIUM DIODE-URANIUM DIOXIDE) MIXED OXIDES

C. N. Craig and W. E. Baily Nov. 1967 56 p refs
(Contract AT(04-3)-189)
(GEAP-5556) Avail: CFSTI

The effect of changes in stoichiometry and density on the effective thermal conductivity and microstructure of plutonium-uranium mixed oxide fuels irradiated at high ratings (27 to 36 kW/ft) are described and compared with similar UO_2 data. Calculated values for the integrated thermal conductivity of $(Pu_{0.2}U_{0.8})O_2$ fuel of 1.98 and 2.00 stoichiometry are presented. Author (NSA)

N69-14354# Dow Chemical Co., Golden, Colo. Rocky Flats Div.

STATIC REACTOR REDUCTION OF PLUTONIUM HEXAFLUORIDE WITH IODINE AND HYDROGEN

James D. Navratil, Ralph O. Wing, Garrel F. Molen, and Jerry D. Moseley 6 Sep. 1968 12 p refs
(Contract AT(29-1)-1106)
(RFP-993) Avail: CFSTI

Experiments are described that are part of an effort to develop and evaluate a plutonium hexafluoride volatility process for the recovery and purification of plutonium from a variety of impure materials. Hydrogen and iodine were used to reduce PuF_6 to PuF_4. With proper equipment and techniques, both reductants were found to be capable of quantitatively reducing PuF_6. PuF_4 from I_2 reductions was found to contain up to several wt % of metallic impurities. PuF_4 from the H_2 reduction contained from a few hundred ppm to several wt % of metallic impurities. The bulk of the impurities was traced to materials used in construction of the reactor. The results indicated that the H_2 reduction step should be investigated further. Details of equipment and procedures not described previously are included. Reduction bomb pressures and temperatures are given as well as physical and chemical data on the PuF_4 product. Author (NSA)

N69-14373# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.

ITERATIVE UNFOLDING OF COMPTON SPECTRA

M. G. Silk Jun. 1968 21 p refs
(AERE-R-5653) Avail: CFSTI

The iterative method of solving the Fredholm equation was considered as a means of unfolding Compton spectra, and numerical experiments, using both experimental and imaginary spectra, were carried out to determine the suitability of the technique for this problem. Particular regard was paid to the possibility of unfolding the Compton spectrum produced by the γ-ray flux in a nuclear reactor. Author (NSA)

N69-14425# Argonne National Lab., Ill.

DETERMINATION OF GAMMA-RAY HEATING IN A CRITICAL FACILITY BY THERMOLUMINESCENT DOSIMETRY

George S. Stanford and Ted W. Johnson Feb. 1968 45 p refs
(Contract W-31-109-ENG-38)
(ANL-7373) Avail: CFSTI

Because of good sensitivity, small probe size, and relative ease of handling, thermoluminescent dosimetry (TLD) provides a useful method for measuring gamma-ray heating in critical facilities. The Bragg—Gray principle of cavity ionization is useful in analyzing the data if thin layers of phosphor, surrounded only by the material in which heating is to be measured, are used. Measurements made during critical experiments for the Agronne Advanced Research Reactor are reported. The phosphor used was CaF_2: Mn. Investigation of sensitivity to thermal and fast neutrons failed to reveal any appreciable perturbations under the experimental conditions encountered. Reproducibility of relative measurements was about 5 to 10%, which was adequate for the purpose; refinements in technique could improve on that. For absolute measurements, there were additional uncertainties: ±15% in the measurement of the absolute power of the critical facility and approximately ±10% in a spectrum correction factor. Author (NSA)

N69-14441# Oak Ridge National Lab., Tenn. Neutron Physics Div.

A SURVEY OF RECENT SOVIET RADIATION SHIELDING WORK

J. Lewin, J. Gurney, and D. K. Trubey Sep. 1968 357 p refs
(Contract W-7405-ENG-26)
(ORNL-RSIC-23) Avail: CFSTI

A literature survey of Soviet nuclear radiation shielding work, with emphasis on reactor shielding, is presented along with indexed compilations of authors, publications, and abstracts of these publications. The publication period covered in the interval from the Third Geneva Conference, 1964, to the end of the year 1967. Lists of selected periodicals and publications, translated extracts from several significant publications, and a resume of shielding research facilities and equipment are also presented. Author (NSA)

N69-14481*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PREDICTIVE EQUATIONS FOR THERMAL NEUTRON FLUX PERTURBATION EFFECTS IN CYLINDERS

John H. Lynch and Lawrence E. Peters, Jr. Washington Dec. 1968 24 p refs
(NASA-TN-D-4949) Avail: CFSTI CSCL 18K

The thermal neutron flux perturbation, depression, and self-shielding factors were measured for several cylinders having different materials and dimensions. The measurements were done for the high-flux test positions of the Plum Brook Reactor. Results of these measurements were fitted to polynomials that can be used by designers of irradiation experiments to predict flux perturbation effects in test specimens. The experiment design, results, and uncertainty are discussed. The behavior of the perturbation factor around the experiment design center is also examined. Author

N69-14503*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TRANSFER FUNCTIONS FOR RADIATOR DYNAMICS IN THE SNAP-8 SYSTEM

Robert W. Leko and Kent S. Jefferies Washington Dec. 1967 22 p refs
(NASA-TN-D-4946) Avail: CFSTI CSCL 18N

An analytical study was conducted to determine approximate radiator transfer functions for use in SNAP-8 ground test facilities. Theoretical equations for transient heat transfer and flow processes in the radiator were programmed on a digital computer. With this

computer simulation, the frequency response of the radiator-outlet temperature was determined. Approximate transfer functions were determined from the frequency-response information. The transfer function determined for outlet temperature to inlet temperature was a single lag of third order cascaded with a dead-time function. The time constant and dead time were inversely proportional to flow rate. The simplified transfer function chosen to describe the response of outlet temperature to inlet flow rate was a first-order lag. The first-order lag time constant was in inverse proportion to the flow rate. Author

N69-14510# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

USE OF NUCLEAR RECOIL FOR SEPARATING Ra 228, Ra 224, AND Pa 233 FROM COLLOIDAL THORIUM [UTILISATION DU RECOIL NUCLEAIRE POUR LA SEPARATION DU Ra 228, DU Ra 224 ET DU Pa 233 A PARTIR D'HYDROXYDE DE THORIUM COLLOIDAL]

Jacqueline Beydon and Irene Gratot Apr. 1968 8 p refs In FRENCH

(CEA-R-3493) Avail: Issuing Activity

By using α recoil it is possible to separate by dialysis the α disintegration products (^{224}Ra, ^{228}Ra) of thorium from colloidal thorium hydroxide. The use of n,γ recoil allows the separation of ^{233}Pa produced by the neutron irradiation of thorium, on condition that the colloidal thorium hydroxide is irradiated in the presence of a dispersing agent. Author (NSA)

N69-14535# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PCTR MEASUREMENT OF k SUB INFINITY FOR URANIUM THORIA SUPERCELL

A. D. Vaughn and R. M. Fleischman 31 Jul. 1968 58 p

(BNWL-792) Avail: CFSTI

Experimental measurements were made on a test lattice of separable tubes of fuel and target material in a graphite-moderated lattice in the PCTR. Measurements were made of the infinite medium neutron multiplication factor on a defined supercell of three uranium fuel cells and one ThO_2 target cell. The measured parameters include data for two distinct fuel types in lattices with and without coolant consisting of 1.25 wt % enriched uranium fuel and ThO_2 target at 77% theoretical density in separate process tubes. Determinations of k_∞ were made with the coolant channels wet and dry and with two differing fuel sizes to obtain an estimate of the change in reactivity due to water loss as a function of coolant and fuel geometry. Author (NSA)

N69-14554# European Atomic Energy Community, Brussels (Belgium).

DEVELOPMENT OF A COMPLETELY HYDRAULICALLY ACTUATED AND CONTROLLED SHUTDOWN AND CONTROL SYSTEM FOR WATER AND STEAM COOLED REACTORS

O. Muehlaeuser [1968] 39 p refs Transl. into ENGLISH from Kernsforschungszentrum Rept. KFK-865, Nov. 1967

(EURFNR-497; EUR-3699.d) Avail: CFSTI

A description is presented of a completely hydraulic control rod drive system, in which control rod movement is actuated and recorded hydraulically. The control rod is moved by a hydraulic piston motor of conventional design. The drive system incorporates a clamp which reacts to the coupling pulses of the follower hydraulic and precludes accidental uncontrolled insertion of the control rod into the core. Also described for the system are a fast valve, a braking-damping spring set, potentiometer, and piston motor and clamp. Author (NSA)

N69-14685# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.

ZIRCALOY-CLAD UO_2 FUEL ROD EVALUATION PROGRAM Quarterly Progress Report, Feb. 1968

F. H. Margarth, comp. May 1968 34 p

(Contract AT(04-3)-189)

(GEAP-5624; QPR-2) Avail: CFSTI

The operation of Assembly SA-1 during this period was limited to three days. The Dresden reactor was shut down for refueling and general maintenance. Assembly SA-1 was leak tested by the sipping technique with no indication of fuel rod failure. The estimated average and peak exposure values for SA-1 remain at 7.5×10^{20} fissions/cc (27,200 MWd/stU) and 12.2×10^{20} fissions/cc (44,500 MWd/stU), respectively. Examinations and analyses were conducted on the 10 fuel rods permanently removed from Assembly SA-1. Relative burnups and power on both a rod-to-rod basis and axial location on a given rod basis were determined from gamma scans on all rods. Author (NSA)

N69-14688# Kernforschungsanlage, Juelich (West Germany).

RELEASE OF FISSIONABLE MATERIAL AND FISSION PRODUCTS FROM NUCLEAR FUELS AND SINTERED MICROSPHERES AT HIGH TEMPERATURE [SPALTSTOFF- UND SPALTPRODUKTABGABE AUS KERNBRENNSTOFFEN BZW. SCHALENKOERNERN BEI HOHEN TEMPERATUREN]

E. Merz and M. Laser Sep. 1968 22 p refs In GERMAN

(Contract EURATOM-003-63-1-RGAD)

(EUR-4059d) Avail: CFSTI

Uranium, thorium and their compounds, as well as sintered microspheres of fissile and fertile materials were irradiated and heated up to temperatures from 1800 to 2000°C in vacuo. The vaporized components were condensed on a water-cooled aluminium condenser foil and analyzed by α-, β-, and γ-spectrometry. As indicated by the results, the rate of vaporization of uranium and thorium on the one side, and of the fission products on the other side are not connected by a simple relation. However, some transport and vaporization mechanisms are discussed. Author

N69-14727# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

TWO DB USER'S MANUAL

W. W. Little, Jr. and R. W. Hardie Jul. 1968 123 p refs

(Contract AT(45-1)-1830)

(BNWL-831) Avail: CFSTI

2DB is a two-dimensional (X-Y, R-Z, R-θ), multigroup diffusion code for use in fast reactor criticality and burnup analysis. The code can be used to: compute k_{eff} and perform criticality searches on buckling, time absorption (α), reactor composition, and reactor dimensions by means of either a flux or an adjoint model; and compute material burnup. All programming is in FORTRAN-IV. Since variable dimensioning is employed, no simple restrictions on problem complexity can be stated. However, in a 65K memory, the current version is nominally restricted to 50 energy groups. Running time (for a k_{eff} calculation) on a UNIVAC 1108 is about 1 minute for a 30 x 30 mesh problem using 4 energy groups. Author (NSA)

N69-14730# Japan Atomic Energy Research Inst., Tokyo.

RICM 2: A CODE FOR SOLVING THE SLOWING DOWNS OF NEUTRONS OVER MANY RESONANCE LEVELS IN TWO-REGION LATTICES

Hiroshi Mizuta, Tokanobu Kamei, and Yuzo Fukai Oct. 1968 27 p refs In ENGLISH and JAPANESE

(JAERI-1170) Avail: CFSTI

A new code, RICM2, is programmed which solves the continuous slowing down of neutrons a wide energy range covering many resonances of no more than two kinds of nuclides in a

two-region lattice. Descriptions are given of resonance cross sections, collision probabilities in two-region lattices, numerical solution of the slowing down equations, and clearcut definitions of various reaction rates, average cross sections and effective resonance integrals. An interesting parameter which indicates relative distributions of absorptions by two nuclides is also introduced. A brief description of the programs and directions for their use conclude the report together with sample problems. Author

N69-14731*# Nuclear Utility Services, Inc., Washington, D. C.
RADIOLOGICAL CONTROL PROCEDURES APPLICABLE TO RADIOISOTOPE THERMOELECTRIC GENERATOR SNAP-27. VOLUME 1: NORMAL OPERATIONS
Luis F. Garcia and Harry W. Calley 12 Sep. 1966 59 p refs
(NASA-CR-98698; NUS-301-Vol-1) Avail: CFSTI CSCL 18N

The radiological control procedures applicable to the normal transport, handling, and storage of the radioisotope thermoelectric generator (SNAP-27), prior to launching, are discussed. Procedures and standards, based on standards of the AEC and other regulatory agencies, are established for permissible doses, levels, and concentrations, classification and posting of storage areas, instruction of personnel, monitoring of storage areas and personnel, and precautions and regulations relating to the off-site transport of radioactive materials. The procedures and standards relate only to routine handling by the SNAP-27 custodial staff. NSA

N69-14732*# Nuclear Utility Services, Inc., Washington, D. C.
RADIOLOGICAL CONTROL PROCEDURES APPLICABLE TO RADIOISOTOPE THERMOELECTRIC GENERATOR SNAP-27. VOLUME 2: RADIOLOGICAL EMERGENCIES
Luis F. Garcia and Harry W. Calley 30 Sep. 1966 68 p refs
(NASA-CR-98697; NUS-301-Vol-2) Avail: CFSTI CSCL 18N

Emergency procedures applicable to potential radiological accidents that may occur during handling, storage, and transport of the radioisotope thermonuclear generator (SNAP-27), prior to launching, are discussed. Procedures and limits, based on standards of applicable regulatory agencies, are established for peacetime emergencies including external and internal exposure of personnel and the general population; ^{238}Pu contamination guides; guidelines for preplanning responses to emergency situations by management, health physics groups, and medical groups; emergency equipment; and practice drills. Criteria for determining the existence of an accident and action to take during handling and storage, alarm systems, scram rules, and evacuation procedures are also discussed. Criteria and action, including notification of proper civil and government authorities and news along with the procedure for detection and recovery of lost capsules. NSA

N69-14754# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.
POST-IRRADIATION EXAMINATION OF ZIRCALOY-2- AND INCOLOY-800-CLAD FUEL RODS IRRADIATED TO 7000 MWd/TU IN THE CONSUMERS BIG ROCK POINT REACTOR
V. F. Hazel Apr. 1968 18 p refs
(Contract AT(04-3)-361)
(GEAP-5626) Avail: CFSTI

Irradiated fuel rods, from the Big Rock Point Reactor, were given a nondestructive examination consisting of visual inspection, gamma scanning, dimensional profiling, and leak testing. Two Zircaloy-2 clad rods were examined by neutron radiography and metallographic methods to determine failure mechanisms. Visual examination of a failed fuel rod clad with Incoloy-800 revealed straight line cracks, probably initiated at the tube weld seam, of an intergranular nature, which may indicate that this cladding material is inferior to Zircaloy-2. The various types of failures are illustrated photographically. NSA

N69-14785# Reactor Centrum Nederland, Petten.
INCIDENT FOLLOWING FAILURE OF A FUEL IRRADIATION CAPSULE IN THE HFR, MAY 7, 1968
J. J. M. Snapvangers Jul. 1968 52 p
(RCN-99) Avail: CFSTI

On May 7, 1968, a failure occurred in one of the fuel irradiation experiments, located in the poolside facility of the Materials Testing Reactor (HFR) at Petten, whilst the reactor was being brought to full power. Incorrect positioning of the experiment, which passed unnoticed during the reactor check-out before start-up, resulted in overheating of the fuel specimen. Melting of the fuel occurred and gaseous and volatile fission products were released in large quantities to the pool water. This report reviews the incident and its causes, the actions which were undertaken after the incident, results of measurements on radiation and activity levels, released quantities of activity and the experience gained from the incident. Author (ESRO)

N69-14823# Atomic Energy Commission Research Establishment, Riso (Denmark).
METALLURGY DEPARTMENT ANNUAL PROGRESS REPORT, PERIOD ENDING 31 MAR. 1968
Jul. 1968 43 p refs
(RISO-179) Avail: CFSTI

The research work in reactor metallurgy was centred on problems connected with fuel elements for power and research reactors and steel for pressure vessels. The research work in the field of general metallurgy was concentrated on strengthening processes in metals, especially dispersion strengthening, fibre reinforcement and texture strengthening. The fuel-element work carried was concerned with zircaloy uranium-dioxide elements for power reactors cooled with water as well as with plate fuel elements for research reactors. In the fields of irradiation and post-irradiation the main work consisted in developing in-pile facilities for fuel-pin irradiation and techniques for examination of irradiated fuel elements. The research work with canning materials on a zirconium basis included studies on hydride formation and corrosion testing of a number of zirconium alloys. Work with uranium dioxide included irradiation of pellets to a maximum burn-up of 12,000 MWD/t. Author

N69-14878# Reactor Centrum Nederland, Petten.
STATISTICAL METHODS IN EXPERIMENTAL REACTOR KINETICS AND RELATED TECHNIQUES
J. B. Dragt, ed. Jul. 1968 553 p refs Symp. held at Petten, Neth., 12–19 Dec. 1967
(RCN-98) Avail: CFSTI

Symposium papers on reactor physics are presented. For individual titles see N69-14879–N69-14907. ESRO

N69-14879# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
REVIEW OF REACTOR KINETICS WORK IN BELGIUM
J. Debrue, ed. *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 1–15 refs (See N69-14878 04-22)
Avail: CFSTI

Work on reactor kinetics performed at the Belgian Center for Nuclear Energy at Mol on the BR2 reactor and its mock-up BRO2, at the University of Brussels, at the University of Leuven and at the Ateliers de Constructions Electriques de Charleroi (ACEC) are presented. This research work is strongly related to the control and safety problems raised by the operation of nuclear reactors. Since November 1955 data has been accumulated. These results are compared with theoretical assessments with the aim of adjusting the kinetical and dynamical parameters of the system. Three types of transients have been recorded and analyzed. They are the xenon transient in case of power and load variations, the power plant short term transient in case of sudden load drop and reactivity perturbation. ESRO

N69-14880# Reactor Centrum Nederland, Petten.
REVIEW OF REACTOR KINETICS WORK IN THE NETHERLANDS
J. B. Dragt *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 17–23 (See N69-14878 04-22)
Avail: CFSTI

Work on nuclear reactor in the Netherlands is presented. Nuclear reactors are listed and the work performed on each is analyzed. ESRO

N69-14881# Louvain Univ. (Belgium).
APPROXIMATE SOLUTION OF THE POINT REACTOR KINETIC EQUATIONS, USING A ONE DELAYED NEUTRON GROUP MODEL, FOR A GAUSSIAN WHITE NOISE REACTIVITY INPUT
W. L. Dutre *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 27–39 refs (See N69-14878 04-22)
Avail: CFSTI

The statistical methods, actually used in determining the kinetic parameters of multiplying systems, are generally based on a linearized analysis of the point reactor kinetic equations, considering the reactor as a time invariant system. The question arises how far the results obtained from experimental measurements, interpreted by means of this linearized analysis, represent the behavior of the time variant reactor system. Therefore an attempt has been made to solve the point reactor kinetic equations for an externally applied Gaussian white noise reactivity input, i.e. to calculate the reactor power level autocorrelation function as well as the power spectral density function. From the analytical expressions obtained, in terms of the kinetic parameter β/l, non linear correction terms to the autocorrelation time and the high frequency breakpoint of the power spectrum can be evaluated. These correction terms appear to be important in the case of fast reactors.
Author (ESRO)

N69-14882# I.V. Kurchatov Inst. for Atomic Energy, Moscow (USSR).
MULTIDIMENSIONAL NEUTRON FLUCTUATIONS IN THE NUCLEAR REACTOR
V. V. Bulavin *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 41–61 refs (See N69-14878 04-22)
Avail: CFSTI

The theory of the stochastic process of neutron multiplication is used in the case of multidimensional neutron fluctuations. The most general method of analytical determination of the law of probability codistribution for the system of an arbitrary finite number of random values is described on the basis of the one velocity diffusion model. Each of these values is the instantaneous value of neutron numbers in different arbitrary volumes, belonging to the volume of a finite convex reactor at different times. The exact equations for generating functions of codistributions of probabilities of the random values mentioned above are obtained. These equations allow to determine rather easily not only simple characteristics of random values (variance, auto- and cross-correlation functions) but also simple and mixed moments of higher order which are necessary for proper interpretation of the experimental data and for the analysis of statistical experimental errors.
Author (ESRO)

N69-14883# Reactor Centrum Nederland, Petten.
THE PRACTICAL USE OF THE P-METHOD AND THE NUMERICAL CALCULATION OF THE PROBABILITY DISTRIBUTION OF NEUTRON COUNTS
Erdinc Tuerkcan *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 63–70 refs (See N69-14878 04-22)
Avail: CFSTI

The probability method in reactor noise analysis is the Russian technique of deriving reactor parameters for the experimentally determined p_k for detecting k neutrons in a certain time interval. It is shown that, besides a direct analysis of P_o, also the use of p_1 of p_{even} is feasible. Some difficulties met in the analysis of the experimental data are discussed. In this paper some approximations of the p_k and the derivation of numerical technique (multiple recursion process) for the probability distribution of neutron counts are considered.
Author (ESRO)

N69-14884# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
STATISTICAL METHODS IN EXPERIMENTAL REACTOR PHYSICS AND SOME OF THEIR APPLICATIONS
V. A. Kuznetzov and A. I. Mogilner *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 71–77 ref (See N69-14878 04-22)
Avail: CFSTI

Statistical methods have great importance for experimental investigation of nuclear reactors. Some aspects of the use of probability functions are analyzed and practical results are presented. It is shown that the introduction of statistical methods in practice will depend on the level of automation of experimental arrangements.
ESRO

N69-14885# Reactor Centrum Nederland, Petten.
REVIEW OF REACTOR NOISE INSTRUMENTATION AND EXPERIMENTS AT R.C.N., PETTEN
J. B. Dragt *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 79–89 refs (See N69-14878 04-22)
Avail: CFSTI

The instrumentation for measurements with ionization chambers and with neutron counters, using digital techniques throughout, is described. The history of the experiments is reviewed and a complete list of the publications that have arisen from the reactor is given.
Author (ESRO)

N69-14886# Reactor Centrum Nederland, Petten.
THE EXPERIMENTAL SET-UP FOR THE PULSED NEUTRON MEASUREMENT TECHNIQUE
T. D. Oei *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 91–98 (See N69-14878 04-22)
Avail: CFSTI

The experimental set-up of the equipment used for the pulsed-neutron experiment for reactivity measurements in multiplying media is described. The set-up consists of a pulsed-neutron source, amplifiers of the counting channels, a time analyzer and a 'buffer register'. The buffer register in aid to the 400-channel time analyzer makes it possible to measure the flux response of the reactor at maximum four different detector locations simultaneously.
Author (ESRO)

N69-14889# Reactor Centrum Nederland, Petten.
EXPERIMENTAL STUDY OF DIFFERENT TECHNIQUES FOR ANALYZING REACTOR NOISE MEASURED BY A NEUTRON COUNTER
Erdinc Türkcan and Jan B. Dragt *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 181–218 refs (See N69-14878 04-22)
Avail: CFSTI

For gaining some insight in the merits of a number of different techniques, existing for the analysis of reactor noise measured by a neutron counter, an experimental comparison was made of seven different techniques. The same measurement was analyzed by means of a digital computer by determining Feynman's variance-to-mean ratio, Bennett's delta variance, the autocorrelation function, a special third order moment, and the probabilities for zero, one or an even number of counts (for the so-called p-methods, viz. p_o,p_1 and p_{even} respectively). All quantities were fitted

to the theoretical expressions by the method of least squares, where in case of the first three types of analysis a correction for delayed neutrons and for finite measuring time was applied. The different types of analysis yield the same values for the two reactor parameters involved. Bennett's technique appears to be the most accurate one, although it is a bit sensitive to higher mode effects. It is the first time that results with the third order moment method and the p_1 and p_{even} -techniques are reported. The results are in good agreement with the theory. Author (ESRO)

N69-14890# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
COMPARISON OF NEUTRON LIFETIME MEASUREMENT RESULTS MADE BY STATISTICAL AND 1/v-METHOD
A. I. Mogilner, G. P. Krivelev, V. M. Steclovsky, and D. M. Shvetzov *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 219–228 refs (See N69-14878 04-22)
Avail: CFSTI

In this work prompt neutron lifetime measurement results are presented. The measurements were made by statistical (frequency) and '1/v-type absorber' methods for three uranium-beryllium assemblies. The cores of the assemblies had the same composition; one of the assemblies had a steel reflector; two others had beryllium reflectors of different thicknesses. The measurement results were compared with multigroup calculation in diffusion approximation. It was found that even for such a complicated system as a beryllium reflected reactor the point model can be applied. The '1/v-type absorber' method of measurements needs a lot of time for experiments; the large gradient of neutronflux at the corereflector boundary makes the integrating procedure of small reactivity effects all over the reactor volume difficult. Disagreement between the calculational and statistical method from one side, and the '1/v-type absorber' method from another, observed for one of the assemblies, can be explained by this reason. Author (ESRO)

N69-14891# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
MEASUREMENT OF ABSOLUTE REACTOR POWER AND EFFECTIVE FRACTION OF DELAYED NEUTRON
A. I. Mogilner, L. P. Krivelev, S. A. Morosov, and D. M. Shvetzov *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 229–238 refs (See N69-14878 04-22)
Avail: CFSTI

The measurements of absolute reactor power have been carried out for different assemblies of the PF-4 reactor with the help of statistical and non-statistical methods and the results of these measurements are presented. During the power spectral density measurements the square detection was substituted by a linear one. The validity of this operation is given. Both statistical and non-statistical reactor power measurement methods have allowed to determine the quantity β_{eff} in two experiments. The measurement results are compared with the calculation and with independent measurements made for an assembly. Author (ESRO)

N69-14892# Reactor Centrum Nederland, Petten.
PRELIMINARY RESULTS OF THE NOISE MEASUREMENTS AND THE CALCULATIONS OF THE PUK CORE IN KRITO
Erding Türkcan *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 239–277 refs (See N69-14878 04-22)
Avail: CFSTI

A preliminary study of PUK clean core in KRITO facility has been carried out with existing nuclear cores. One and two dimensional four energy groups criticality calculations have been performed. The delayed neutron fraction β_{eff} is calculated with the spectrum method, neglecting all space effects. Neutron lifetime calculations have been done by means of applying a 1/v perturbation to the criticality calculations. The detector efficiency in the center of the core is calculated by integrating the thermal group fluxes over the detector position. The reactor noise experiments have been done by means of the current method (autocorrelation by using an ion chamber) for the critical reactor and subcritical measurements have been made with neutron counters (BF_3). The prompt neutron decay constant and a quantity related to detector efficiency are obtained for many water levels, corresponding to subcriticalities down to −16 dollars (k ≈ 0.875) with seven different analyzing techniques. The calculated and the measured reactor parameters are compared. Author (ESRO)

N69-14893# Gosudarstvennyi Komitet po Ispolzovaniu Atomnoi Energii, Obninsk (USSR).
THE COHERENT METHOD OF SUBCRITICALITY MEASUREMENT
A. I. Mogilner and N. A. Ariskin *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 279–290 refs (See N69-14878 04-22)
Avail: CFSTI

The statistical methods have less systematic errors when subcriticality measurements are carried out, than usual methods; still these errors are significant because of the above-mentioned effect. Since 1964 work has been performed concerning the realization of a device for measurement of large negative reactivity with small systematic errors. The coherent method was worked out. An analyzer was made which has been investigated during a long-term test on the PF-4 reactor. The results of the experiments are in good agreement with work carried out in Germany. Author (ESRO)

N69-14894# Reactor Centrum Nederland, Petten.
THREEFOLD CORRELATIONS IN REACTOR NOISE
J. B. Dragt *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 291–300 refs (See N69-14878 04-22)
Avail: CFSTI

A simple theory is given on correlations between three neutrons, detected in counters in a reactor. The threefold correlations are shown to be due to two different branching processes in the chains of fission events. In the dominating and easily measurable process only splitting of the fission chains into two branches is detected. In the other process triple splitting of the fission chain is involved. It appears that this process can provide new physical information; in particular reactor power and delayed neutron fraction can be found without the need for any other static measurement. A special third order moment is proposed for the measurement of this process. An experiment is described that has been performed at Petten, for the determination of this third order moment by means of an on-line computer. This experiment was not successful, however. The cause of the failure becomes clear when the higher modes of space and energy dependence are taken into account in the theory. This modal theory and its consequences are given. Author (ESRO)

N69-14895# I. V. Kurchatov Institute for Atomic Energy, Moscow (USSR).
ENERGY CORRELATION OF NEUTRONS IN THE REACTOR AND THE PROBLEM OF EXPERIMENTAL DETERMINATION OF TWO-GROUP CONSTANTS
V. V. Bulevin *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 301–337 refs (See N69-14878 04-22)
Avail: CFSTI

The stochastic process of neutron multiplication in the homogeneous bare reactor is investigated in two-group energy

approximation on the basis of the 'point' model. The division of the whole neutron spectrum into two energy regions is assumed to occur at the effective cadmium cut-off energy. In the paper the stochastic process of recording of neutrons of each energy group, using the appropriate detectors in the reactor, is studied as well. The analytical expressions for auto- and cross- correlation functions of the counting rate of the two detector types are obtained, which can be used for experimental determination of the two-group constants averaged over the neutron spectrum in a homogeneous multiplying medium. Author (ESRO)

N69-14896# Reactor Centrum Nederland, Petten.
ANALYSIS OF REACTOR NOISE MEASURED IN TWO WEAKLY COUPLED REACTOR CORES
J. B. Dragt *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 339–358 refs (See N69-14878 04-22)
Avail: CFSTI

By determining the correlation between the fluctuations in the signals of two neutron detectors in two different regions of a reactor, information can be obtained on the neutronic coupling between these regions. An outline is given of the theory for the case of a reactor composed of two loosely coupled cores, using the Baldwin model. By comparing the cross-correlation function of the outputs of two ionization chambers near to each core, with the cross-correlation function for two detectors in the same core, the coupling coefficient can be found. The experiment has been performed with the low flux reactor at Petten, loaded with a two-slab core, and with properly positioned ionization chambers. Author (ESRO)

N69-14897# N. V. Tot Keuring Van Electrotechnische Materialen, Arnhem (Netherlands).
NOISE ANALYSIS OF A NEAR CRITICAL HOMOGENEOUS CIRCULATING FUEL REACTOR
A. Kempkes *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 359–379 (See N69-14878 04-22) refs
Avail: CFSTI

The neutron flux fluctuations in a homogeneous near critical assembly were analyzed by correlation techniques. From the high frequency noise in the Rossi-α the fluctuations could be determined. The correlation function of the low frequency reactor noise has a significant dominant period of about 9 seconds at a fuel temperature of 80°C. At a lower fuel temperature (25°C) the noise from the reactor is white. The analyses were performed by means of an on-line polarity coincidence correlator. Author (ESRO)

N69-14898# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
DYNAMIC MEASUREMENTS IN NUCLEAR PLANTS PERFORMED ON DIGITAL COMPUTER BY STATISTICAL METHODS
L. V. Konstantinov, A. I. Efanov, B. N. Seliverstov, P. A. Gavrilov, and Yu. M. Bykov *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 381–395 (See N69-14878 04-22) refs
Avail: CFSTI

In an attempt to obtain the continuous processing of statistical data using a digital computer, special attention was paid to information processing, measuring time required, auto-correlation function power spectral measurements, optimum flattening filter under cut-off conditions of correlation functions. Experiments were performed on a pool-type reactor and a rig, simulating the thermal and physical conditions of a boiling tube-type reactor. Random signal information was analyzed on 'BESM-ZM' digital computer using an on-line processing scheme with a card-type data storage. Transfer functions in the frequency range of 0.1 to 50 cps, the value of $1/\beta$ eff and the detector efficiency were obtained from inpile detector current noise analysis. Considerable changes in power spectral density were observed under boiling simulating conditions when mechanical vibration takes place in the core due to coolant circulation. Dynamic measurements in a rig steam generating channel established the relationship between the spectral composition of a void fraction signal at the channel outlet and the pulsation stability margin. The results obtained show that reactor power spectral response to various disturbances can be used as a useful means to reveal deviations in the technological regime. Author (ESRO)

N69-14899# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnii Energii, Obninsk (USSR).
INFRALOW FREQUENCY POWER FLUCTUATIONS IN A POWER REACTOR
A. I. Mogilner *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 397–408 refs (See N69-14878 04-22)
Avail: CFSTI

It has been shown that in the very low frequency region the reactor with simple feedback (negative temperature reactivity coefficient) often behaves as a harmonic oscillator with Brown forces. The use of such an ideal model, nevertheless, allows (under some conditions) to determine such reactor characteristics as temperature reactivity coefficient, time constant, their dependence on reactor working conditions and their evolution during the campaign. The effectiveness of this asymptotic model has been illustrated with the help of heavy-water boiling reactor HBWR-2. The analysis of its noise allows to estimate the above-mentioned quantities and the thermal conductivity coefficient. Another example gives the results of the experiment when an artificial unstability is produced; the simplicity of its analysis helped to determine the absolute power. Author (ESRO)

N69-14900# Research Inst. for Nuclear Reactors, Melekess (USSR).
THE APPLICATION OF THE NOISE ANALYSIS WHEN INVESTIGATING THE BOILING WATER REACTOR DYNAMICS
B. V. Kebadze, V. M. Grjazev, I. N. Sokolov, V. A. Afanasiev, and L. A. Adamovsky *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 409–425 refs (See N69-14878 04-22)
Avail: CFSTI

Some results of the dynamic investigations of the boiling water reactor by means of the noise analysis are presented. The dynamic behavior of the VK-50 reactor (boiling water reactor), the instrumentation and data reduction methods are briefly described. The investigated different parameter data (neutron flux, steam content, inlet flow rate) at different reactor operating conditions, including those near the limit of stability, are presented. The use of the damping time constant of the neutron flux correlation function for predicting the stability limit is demonstrated. Interpretation of the power spectral densities, along with a number of thermophysical parameters, gives additional information about the dynamic behavior of the natural circuit circulation which is rather difficult to obtain by means of oscillatory methods due to physical and technological causes. The pros and cons of the different instrumentation that are revealed with the help of statistical methods are discussed. Author (ESRO)

N69-14901# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
CONTROL OF REACTOR POWER LEVEL WITH STATISTICAL DISCRIMINATION AGAINST GAMMA RADIATION

A. I. Mogilner and S. A. Morosov *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 427–437 refs (See N69-14878 04-22)
Avail: CFSTI

Determination of reactor power level is an important problem under the conditions of intensive gamma radiation. This problem is usually solved with the help of gamma-bucking ionization chambers as neutron detectors. This allows to spread the dynamic range of power measurements down to 1.5–2 decades. The present report describes the reactor power level determination method with the help of usual neutron current ionization chambers. This method has several advantages over the mean-current method, such as: excellent discrimination against gamma radiation, relative freedom from the effects of cable leakage, etc. In this method the reactor power level is measured by the power spectral density value of a neutron detector current fluctuations. This method was tried on the BR-5 experimental power reactor. As a neutron detector the fission chamber KHT-54 was used (ϵ_n =0.5 pulse·cm^2·sec, $q_n \approx 10^{-13}$ C/pulse). It was discovered that the proportionality between the reactor power level and the value of power spectral density current fluctuation took place in a wider region than that of the same chamber operated in the mean-current mode. The results of measurement of the relative discrimination coefficients for BF_3 ionization and fission chambers are listed. The requirements for neutron detectors are discussed. A circuit based on this method is presented. Author (ESRO)

N69-14902# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
PASSIVE STATISTICAL METHOD FOR REACTOR PARAMETERS DETERMINATION
A. R. Mirsoyan *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 439–458 refs (See N69-14878 04-22)
Avail: CFSTI

The results of noise investigations are being explained with the help of the point model. The model is exact enough to describe some effects. Nevertheless, such an approximation looses a number of important reactor dynamics properties. It is shown in the report that taking the space length into account, leads to the prediction of resonances in spectral power density of neutron flux fluctuations. The analysis is carried out on the basis of a two-region (fuel and coolant) reactor model. It is assumed that the main sources of neutron fluctuations are random oscillation of the coolant temperature, and the reactor power transfer function with regard to reactivity is a smooth function of frequency (one without resonance). It is also shown how to use the resonance frequency and width for reactor parameters determination. The results of the analysis are applied for the explanation of neutron flow noise investigation in the TES-3 reactor. As a result the heat transfer coefficient from fuel to coolant was determined. A passive statistical method is proposed for temperature reactivity coefficient determination. Author (ESRO)

N69-14903# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
THE STUDY OF NUCLEAR POWER REACTOR DYNAMICS BY THE METHOD OF THE STOCHASTIC OSCILLATOR
A. I. Mogilner, V. L. Cherevatenko, V. L. Semenisty, and L. A. Timohin *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 459–491 refs (See N69-14878 04-22)
Avail: CFSTI

The main ideas are presented of the method for measurement of pulse transient response (weighting function) of nuclear power reactor by calculation of the cross-correlation of the reactor reactivity (the position of the control rod) and the power, modulated by a pseudo-random binary signal, simulating 'white' noise. The method allows to obtain more exhaustive information about the reactor dynamics during a minimum period of time in the presence of noise and gives the possibility of automatic processing of the results simultaneously obtaining the weighting function for a wide range of the value of the argument. Due to several reasons the calculated cross-correlation function describes the necessary pulse transient response only approximately; that is why there appears the problem of introduction of a correction and evaluation of errors for the obtained results. The report concerns the main sources of errors. To interpret the results obtained, one can use the mathematical space-time model which uses the separation of the reactor into several zones (the core, the reflector, coolant in the core, etc.). The model is described by a system of heat exchange and kinetics equations. The main demands for the instrumentation, intended for pulse transient characteristic measurement are discussed. The description of three analyzers with the generator of pseudo-random signals is given. Author (ESRO)

N69-14904# Laboratories du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
SURVEY OF EXPERIMENTAL RESULTS FOR LATTICES CHARACTERISTICS DETERMINATION BY PULSED NEUTRON TECHNIQUE
R. Delrue, J. Debrue, N. Haubert, W. Mewissen, and M. Stievenart *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 493–521 refs (See N69-14878 04-22)
Avail: CFSTI

The study of plutonium recycling in light water moderated reactors is of interest, because of the scarcity of plutonium. The possibilities of the pulsed neutron and source jerk techniques were experimentally investigated on subcritical assemblies moderated and reflected with light water and made of UO_2 fuel pins enriched to 5% in U-235. The water to fuel ratio W/UO_2 of the various lattices ranged from 2.63 to 9.35 and the reactivity from 0.7 to 0.98 which represents about 50 to 90% of the critical mass. The problems inherent in the determination of the critical mass, prompt neutron lifetime are discussed. Author (ESRO)

N69-14905# Laboratoire du Centre d'Etude de l'Energie Nucléaire, Mol (Belgium).
PULSED AND MODULATED NEUTRON SOURCE TECHNIQUES AND THEIR INTERRELATION
W. Rotter, N. Maene, and R. Delrue *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 523–554 refs (See N69-14878 04-22)
Avail: CFSTI

The measurements described are part of a general experimental effort to improve the reliability of measurements in highly subcritical lattices. These include prompt neutron lifetime and reactivity measurements. First it was shown that the three common methods (modulation, pulsation, and source extinction) for measuring local reactivities have the same space dependence if the three experiments are performed under exactly similar conditions. This can be expected on theoretical grounds. Defining a transfer function for prompt neutrons, its space dependence can be eliminated to a high degree if only the harmonic free part of the pulse response is used for the analysis. The decay constant α can be determined from this 'reduced' prompt transfer function. The sensitivity of this method on systematic deviations from the pure exponential decay offers some valuable checks in the interpretation of pulsed neutron experiments. Also the constant background, i.e. the delayed neutron tail can be determined with high accuracy. The elimination of the spatial dependence in the transfer functions results in a correction factor for the time integral of the prompt neutron response. When it is applied to Sjöstrand's area ratio the corrected value is in rather good agreement with the extrapolated area ratio (Gozani) and the reactivity obtained by the $k\beta/l$ - method of Garelis-Russell. Author (ESRO)

N69-14906# Laboratoires du Centre d'Etude de l'Energie Nucléaire, Mol (Belgium).
ANALYSIS OF THE MEASUREMENT OF THE REACTIVITY CORRESPONDING TO THE STATIC FUNDAMENTAL MODE OF FAR SUBCRITICAL SYSTEMS
P. Vandeplas *In* Reactor Centrum Ned. Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 555-577 refs (See N69-14878 04-22)
Avail: CFSTI

The present work finds its origin in the difficulties encountered in the interpretation of experimental results of reactivity and prompt neutron decay measurements. The analysis of the different methods of measuring the reactivity by means of a periodical neutron source shows that the ratio of the integrals over a period of the prompt and delayed neutron densities is independent of the shape of the signal. This ratio which is a linear combination of the successive eigenvalues of the system, is equal to the ratio of the prompt and delayed neutron densities existing in the presence of a constant source. As shown by experiment and numerical analysis, this ratio is strongly space dependent. It is shown analytically that the contribution of space harmonics is seriously reduced in the integral over a well chosen volume of the system, for the prompt as well as for the delayed neutron density. By numerical analysis one shows that the ratio of these integrals is practically equal to the reactivity corresponding to the static fundamental mode and quite independent of the source position. This method is compared to other methods used for the elimination of the harmonics contribution. By a suitable choice of the source position the integral over a volume can be reduced to a line integral, which can be performed by a long detector, requiring only one measurement. The optimization of both the source position and the integral limits yielding the best values for the reactivity and prompt neutron decay constant can be achieved on purely experimental criteria. Author (ESRO)

N69-14907# Reactor Centrum Nederland, Petten.
AN EXPERIMENTAL STUDY OF THE REFLECTOR EFFECTS IN PULSED NEUTRON EXPERIMENTS
T. D. Oei *In its* Statist. Methods in Exptl. Reactor Kinet. and Related Tech. Jul. 1968 p 579-600 refs (See N69-14878 04-22)
Avail: CFSTI

The pulsed neutron technique has been applied to determine the reactivity of a sub-critical heavily reflected system. The extrapolated area method as is suggested by Gozani has been used to evaluate the reactivity from the data of such an experiment. The place dependent values of the reactivity, with respect to the detector location, are interpreted in terms of a difference in shape between the prompt neutron submode and the delayed neutron submodes. Author (ESRO)

N69-14983# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
MORPHOLOGY OF THE PHASES PRESENT IN THE UO SUB 2-U SUB 4 O SUB 9 SYSTEM [MORFOLOGIA DELLE FASI PRESENTI NEL SISTEMA UO SUB 2-U SUB 4 O SUB 9]
F. Coppola, C. Fizzotti, and A. G. Gandini 1968 20 p refs In ITALIAN; ENGLISH summary
(RT/MET(68)3) Avail: CFSTI

The structures obtained by high temperature oxidation of $UO_{2.00}$ are shown and described. Slow cooling rates from high temperature yield two phase structures of $UO_{2.00} + U_4O_9$. Fast cooling rates yield at room temperature a metastable solid solution that can be decomposed by thermal annealing. Author

N69-15019# Eidgenossische Technische Hochschule, Zurich (Switzerland).
APPLICATION OF THE SECOND LIAPUNOV METHOD TO THE STUDY OF NUCLEAR REACTOR STABILITY [APPLICATION de la SECONDE METHODE de LIAPUNOV A L'ETUDE de la STABILITE des REACTEURS NUCLEAIRES]
Gerard Burnand (Ph.D. Thesis) Nov. 1967 84 p refs In FRENCH *Its* Thesis No. 4005
Avail: CFSTI

A function of a more general type is considered, which takes into account slow neutrons and permits the study of local stability. The second method of Liapunov is reviewed in terms of its effectiveness as a technique for qualitative analysis of differential systems. Kinetic equations for certain classes of reactors are derived. The Liapunov function is constructed in a general form based on heuristic considerations. An algorithm is formulated to determine certain parameters which are termed coefficients of stabilization. These coefficients are subtracted from the coefficients of reactivity to assure that the reactor is stable in the aggregate. A method of estimating the admissible initial variations is given. Several examples are included to illustrate the application of the method. Transl. by M.G.J.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N69-13902 Lehigh Univ., Bethlehem, Pa.
INFLUENCE OF TEMPERATURE, THERMAL TREATMENT AND Tl CONCENTRATION ON THE OPTICAL PROPERTIES OF NaI SINGLE CRYSTALS
Marco Paolo Fontana (Ph.D. Thesis) 1967 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-4884

It is shown that at high Tl concentrations, where the optical properties are influenced by the single Tl impurity center (monomer) and the dual Tl center (dimer), there is an energy transfer from excited dimer centers to nearby monomer centers. The analysis of the excitation emission spectra of NaI(Tl) at low temperature yields additional information which indicates that the Tl excited states interact with nontotally symmetric lattice vibrational modes (dynamical Jahn-Teller effect). Studies of the effect of thermal treatment on the optical properties of NaI indicated that rapid quenching from a relatively high temperature introduced new absorption and emission bands in the optical spectra of the crystal. The great similarity of these spectra with those of additively colored NaI(I_2) is taken as evidence that the new bands formed upon quenching are due to a new center, the V_F center, made of a hole trapped at a cation vacancy. Various measurements performed on the quenched NaI crystals indicate that the Frenkel mechanism may be responsible for the formation of the V_F centers. Polarized excitation and polarized bleaching showed the V_F center to be completely isotropic. The characteristics of the 371 nm luminescence were determined and interpreted on the basis of the proposed model of the V_F center. It is concluded that the V_F center may be the long sought antimorph of the F center. Dissert. Abstr.

N69-14048 North Carolina Univ., Chapel Hill.
THERMOLUMINESCENCE AND ASSOCIATED PHYSICAL PHENOMENA OF IRRADIATED IONIC CRYSTALS
William Gordon Buckman (Ph.D. Thesis) 1967 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-2160

This study concerned the thermoluminescence, color centers, and the D.C. electrical resistivity of Harshaw "pure" LiF, NaF, NaCl, KCl, and CaF_2 crystals. A quadratic relation was found to exist between the F and M centers in LiF, NaF, and KCl. In general, the emission spectra differed in the different peaks of each glow

curve. However, near room temperature the thermoluminescence spectra were very similar to the emission spectra observed during other modes of excitation (X-rays, electrons, and deformation of previously irradiated crystals). No good correlation was found to exist between the area under the thermoluminescence glow curve and the disappearance of F-centers, when the crystals were heated to successively higher temperatures. Dissert. Abstr.

N69-14133# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE DEVELOPMENT OF A DISCHARGE IN SOLID DIELECTRICS [K VOPROSU O RAZVITII RAZRYADA V TVERDYKH DIELEKTRIKAKH]
V. Ya. Ushakov et al 30 Aug. 1967 7 p refs Transl. into ENGLISH from the Book "Proboy Dielektrikov i Poluprovodnikov" Energiya, Moscow-Leningrad, 1964 p 124–127
(AD-677070; FTD-HT-23-900-67) Avail: CFSTI CSCL 20/3

The channels of incomplete breakdown in rock salt and organic glass are considered. It is shown that the discharge glow zone exceeds by hundreds of times the channel dimensions. It is indicated that thermo-ionization and photoionization processes can occur during the breakdown of dielectrics. Dielectrics having larger dielectric strength have larger discharge-development rates (v). Values v = (200,000 to 15,000,000) cm/sec were obtained and were found to depend on the value of the excess voltage. TAB

N69-14138 Johns Hopkins Univ., Baltimore, Md.
EXPERIMENTAL EVIDENCE SUPPORTING THE UNIT-CELL THEORY OF DIFFRACTION GRATINGS
Frederick Ward Phelps, Jr. (Ph.D. Thesis) 1967 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-6572

Three experiments are described in which reflection gratings, primarily with rectangular profile, are studied largely for the S-polarization, using a microwave spectrometer operating at 1/2 cm. The experiments are related in their concentration on the contributions of small parts of the grating, particularly the unit cell, to the behavior of the whole. The general conclusion is drawn that it is profitable to consider separately the properties of the isolated unit cell and the effects of collecting such cells together to form a grating. The effects of the collection are considered as two-fold: 1) the modification of the isolated cell-pattern by coupling effects, manifested in anomalous behavior; and 2) the manner in which spectra are produced, described by the grating array factor. It is shown that for two gratings having very different profile the shapes of anomalies change surprisingly little as the number of grating lines is reduced from ten to three. The shape of the anomaly for large gratings can be predicted from as few as three lines. A simplified mathematical model is developed, which requires the measurement of the zero order and any two side orders to predict the radiation pattern of a unit cell, whether isolated or part of a grating, as a function of the angle of refraction. Dissert. Abstr.

N69-14140 Northwestern Univ., Evanston, Ill.
DIFFRACTION BY A CIRCULAR ARC REFLECTOR
Ronald Fred Janz (Ph.D. Thesis) 1967 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-3193

A boundary value problem for the scalar diffraction of a plane electromagnetic wave by a perfectly conducting circular arc reflector for the case in which the electric vector is parallel to the generators of the reflector is formulated in terms of a Fredholm integral equation of the first kind by introducing the free-space Green's function and applying Green's theorem. An approximate solution of this equation is obtained at low frequencies by replacing the kernel of the equation by the leading term of its series expansion in powers of frequency. The resulting approximate equation is of the type which arises in potential theory and is solved exactly. The leading two terms of the low-frequency series expansion of the total scattering cross section of the reflector are obtained by substituting the approximate solution of the above integral equation into the Schwinger–Levine variational principle for the cross section. Another estimate of the scattering cross section at high frequencies is obtained by applying a geometrical theory of diffraction to the problem. A correction to the geometrical optics cross section is obtained by determining the contribution of the doubly diffracted rays to the far field in the geometrical shadow. The corrected cross section appears to have the correct frequency dependence as well as dependence on the angle subtended by the reflector. Dissert. Abstr.

N69-14243 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UKRAINIAN JOURNAL OF PHYSICS (SELECTED ARTICLES)
27 Sep. 1967 28 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 10, 1965 p 1101–1122
(AD-677072; FTD-HT-67-411) Avail: CFSTI CSCL 20/2

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2. ON THE DISPERSION OF THE r'_{63} COEFFICIENT OF AN ACTUAL ELECTROOPTICAL EFFECT IN $NH_4H_2PO_4$ CRYSTALS O. G. Vlokh et al p 19–22 refs (See N69-14245 04-23)

N69-14244 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEFORMATION OF OPTICAL INDICATORS WITH QUADRATIC AND SPONTANEOUS ELECTROOPTICAL EFFECTS IN CRYSTALS [DNFORMATSIYA OPTNCHNYKH INDYKATRYS PRY KVADRATYCHNOMU TA SPONTANNOMU ELEKTROOPTNCHNYKH EFEKTAKH U KRYSTALAKH]
O. G. Vlokh *In its* Ukr. J. of Phys. 27 Sep. 1967 p 1–17 refs (See N69-14243 04-23)
Avail: CFSTI

Starting from the tensors of the quadratic electro-optical effect, equations are obtained for the optical indicatrices deformed by an electric field acting in the most important directions of crystals of 32 crystal symmetry classes, in which spontaneous polarization and antipolarization arise in the corresponding directions with possible ferroelectric and antiferroelectric phase transitions. Expressions are also obtained for the orientation of the new optical indicatrix with respect to the initial one. It is concluded that in triclinic and monoclinic crystals with a quadratic effect the field can always produce rotation and deformation of the indicatrix, which depend on the field strength. In orthorhombic crystals the indicatrix is deformed without rotation if the field is along crystal axes. If the field is not along an axis the indicatrix is deformed and rotated, depending on the field. In tetragonal, trigonal, and hexagonal crystals the action of the field in the direction of the optic axis causes deformation without rotation, the crystal remaining uniaxial. If the field is not along the optic axis the crystals become biaxial. Author

N69-14245 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE DISPERSION OF THE r'_{63} COEFFICIENT OF AN ACTUAL ELECTROOPTICAL EFFECT IN PRIMARY AMMONIUM PHOSPHATE CRYSTALS [PRO DYSPERSIYU KOEFITSIYENTA r'_{63} ISTYNNOHO ELEKTROOPTYCHNOHO EFEKTU V KRYSTALAKH PRIMARY AMMONIUM PHOSPHATE]

O. G. Vlokh et al *In its* Ukr. J. of Phys. 27 Sep. 1967 p 19–22 refs (See N69-14243 04-23)
Avail: CFSTI

A static method with application of mechanical stresses was used to obtain the dispersion of the piezo-optical stress coefficient π_{66} and the r'_{63} coefficient of the true electro-optical effect in the visible spectrum. An UM-2 monochromator served as the source of monochromatic light; the detector was a FEU-29 photomultiplier with a M-95 microammeter. The measurements were conducted at room temperature. A special device provided the uniform compression of the ADP crystal along the [110] direction of a sample cut in the form of a right prism 13.243 mm along the [110], 17.48 mm along the [110], and 11.093 mm along the [001]. The values of r'_{63} at a wavelength of 556 mμ obtained by the static method are in good agreement with those obtained by the dynamic method at frequencies somewhat higher than the fundamental resonance frequency. The agreement of these results confirms the reliability of both methods and the phenomenological connection of the electro-optical properties of crystals with their piezo-electric and photo-elastic properties. Author

N69-14360 Purdue Univ., Lafayette, Ind.
EXPERIMENTAL STUDY OF AERODYNAMICALLY GENERATED SOUND DUE TO A ROTATING DISK
Robert Charles Chanaud (Ph.D. Thesis) 1967 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-6289

The sound generated aerodynamically by a relatively smooth disk rotating in its own plane was measured in an anechoic room. Pressure correlations were made near the disk surface in order to learn something of the flow structure. The sound field was found to be random covering a broad frequency range in the audio spectrum. The source was determined to be of dipole nature resulting from fluctuating forces acting on the disk surface due to the turbulent flow over it. The low frequency part of the sound spectrum had a directionality much like that of a point dipole aligned with the disk axis; it was therefore due to a distribution of pressure dipoles acting on the disk faces. The separated flow from the disk edge, which had a well defined periodic vortex development, was the cause of the low frequency sound. The high frequency part of the sound spectrum was omnidirectional except for a sharp reduction in the disk plane. Dissert. Abstr.

N69-14416# California Univ., Berkeley. Lawrence Radiation Lab.
MAGNETIC FIELD COMPUTATION FOR TWO-DIMENSIONAL AIR COIL SYSTEM
Roland Yourd and Klaus Halbach Jul. 1968 30 p refs
(Contract W-7405-eng-48)
(UCRL-18378) Avail: CFSTI

Analytic formulas suitable for numerical computation are derived for two-dimensional air coil systems. The computer code, FIELDS, is described, and evaluation of a sextupole magnet is included as a sample problem. A complete listing of the program coding is also provided in an appendix. Author (NSA)

N69-14485# Washington Univ., Seattle. Dept. of Electrical Engineering.
FLUCTUATIONS OF A BEAM WAVE PROPAGATING THROUGH A LOCALLY HOMOGENEOUS MEDIUM Interim Report
Akira Ishimaru Jul. 1968 39 p refs
(Contract F19628-68-C-0126)
(AD-677003; AFCRL-68-0433; TR-126; SR-1) Avail: CFSTI CSCL 20/14

General formulations for the fluctuations of a beam wave propagating through a homogeneous or locally homogeneous medium are given in terms of the spectral density of the index of refraction. The amplitude and phase correlation functions and the mean square fluctuations are derived for a homogeneous medium showing the dependence on the radial distance in the transverse plane of the beam. The amplitude and phase structure functions are derived for a locally inhomogeneous medium. The correlation functions and the structure functions do not depend only on the difference coordinate, but they are functions of the radial coordinates in the beam cross section. This particular inhomogeneity, however, is shown to be an analytic continuation of the homogeneous or locally homogeneous case. The mean square amplitude fluctuation for the Kolmogorovs locally homogeneous medium is shown to behave as a plane wave for short distance and then becomes less than that of a spherical wave, and its spectrum is shown to behave as $1/K$ for large K in contrast with the plane and spherical waves. The spread of the beam radius is shown to be approximately the $8/3$ powers of the distance L for small distance and its increase depends on the magnitude of the index of refraction fluctuation. Author (TAB)

N69-14519 California Univ., Berkeley.
SPIN WAVE INTERACTION WITH SOUND AND LIGHT WAVES
Gary Lee Thomas (Ph.D. Thesis) 1967 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-5835

The coupling between spin waves and sound waves is due to the magnetostrictive effect. Using the magnetostrictive Hamiltonian the linear theory for this coupling is discussed. Then the nonlinear terms are added to the linear equations, and it is shown that megacycle sound waves can be parametrically produced due to the spatial variation of the magnetostatic modes caused by the boundary of the sample. The plane wave solutions of the nonlinear equations of motion for spin waves and acoustic waves are derived. It is shown that under certain conditions the spin waves can produce unstable acoustic oscillations at the acoustic resonance frequency of the sample. The threshold condition for the microwave power for magnetoelastic instability is calculated and compared with experimental data. The unstable resonance acoustic oscillations extended over a region from $0.5 < \omega_H/\omega < 0.6$. Dissert. Abstr.

N69-14635 Stanford Univ., Calif.
FLUORESCENCE IN ANTIFERROMAGNETIC MnF_2
Richard Lorentz Green (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-8424

This study was undertaken to investigate the effect of magnetic interactions on the optical spectra of ordered magnetic materials. The first observation of sharp line fluorescence in antiferromagnetic manganese fluoride (MnF_2) is reported and two new phenomena associated with this fluorescence are identified. It is shown that the major portion of the fluorescence results from the radiative decay of localized excitons. Localized excitons have been previously identified in the spectra of molecular crystals and semiconductors. The first quantitative evidence for their importance in the spectra of magnetic insulators is presented here. It is also shown that certain transitions in the fluorescence spectrum of MnF_2 correspond to the de-excitation of an excited manganese ion combined with the creation of a spin wave. Such transitions are called spin wave sidebands in analogy with more familiar vibrational (phonon) sidebands. Dissert. Abstr.

N69-14645# Princeton Univ., N. J. Plasma Physics Lab.
CLOSED SPATIALLY PERIODIC MAGNETIC CONFIGURATIONS WITH MINIMUM B
V. M. Glagolev Aug. 1968 64 p refs Transl. into ENGLISH from Russian Rept. IAE-1451
(Contract AT(30-1)-1238)
(MATT-TRANS-58; IAE-1451) Avail: CFSTI

An investigation was made of closed magnetic traps with minimum "B" consisting of segments of magnetic fields having stability in a defined cross section. The minimum "B" in the systems is obtained as a result of lengthening the central lines of force as compared to the peripheral lines of force. Author (NSA)

N69-14779# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Div. d'Acoustique.
GENERAL METHOD FOR CALCULATING THE SOUND PRESSURE FIELD EMITTED BY STATIONARY OR MOVING JETS [METHODE GENERALE DE CALCUL DU CHAMP DE PRESSION SONORE EMIS PAR LES JETS STATIONNAIRES OU MOBILES]
Michel Kobrynski 1968 39 p refs In FRENCH and ENGLISH Presented at the Symp. on Aerodyn. Noise, Toronto, 20–21 May 1968 Submitted for publication
(ONERA-TP-578) Avail: CFSTI

This is the result of a long study, the purpose of which is to obtain a method for calculating the noise from jet engines, applicable to either fixed or mobile jets (airplanes in flight) and into a large angle from the jet axis. Then this computation gives the evolution of the noise spectrum in octave bands and the variation of the level in PNdB. The main parameters of the jet and the characteristics of the airplane trajectory are needed for the computation. The over all S.P.L. in a point of the far noise field is determined from the overall acoustic power emitted, the magnification of the sound pressure due to the convection of eddies in the jet and some corrections for Doppler effect. The acoustical spectrum related to this sound pressure is afterwards determined from the generalized spectrum described with respect to suitable non-dimensional coordinates and pertaining to the direction considered. The experimental verifications of this method, performed with axi-symmetric jets, under or slightly overchocked, and flight Mach numbers up to 0.6, are in good agreement with computed results. Applying this process leads in particular to the prediction of the 'Effective PNdB' level involving the noise duration. Author (ESRO)

N69-14798*# Techtran Corp., Glen Burnie, Md.
RESISTANCE VARIATION OF METALS IN A MAGNETIC FIELD [UEBER DIE WIDERSTANDSAENDERUNG VON METALLEN IM MAGNETFELD]
Serban Titeica Washington NASA Jan. 1969 32 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 22, ser. 5, 1935 p 129–161 Submitted for publication
(Contract NASw-1695)
(NASA-TT-F-12041) Avail: CFSTI CSCL 20C

Theories on the problem of resistance variation of metals in a magnetic field are refined by taking account of the quantization of the paths of electrons in the magnetic field. Comparisons with experimental results are depicted. In the case of bismuth, it is concluded that the number of conduction electrons is considerably less than the number of atoms. Author

N69-14815*# TRW Systems Group, Houston, Tex.
COMPUTATION OF LIGHTING AND VIEWING ANGLES
4 Oct. 1968 8 p
(Contract NAS9-8166)
(NASA-CR-92457; TRW-11176-H046-R0-00) Avail: CFSTI CSCL 20F

Bidirection reflectivity measurements of samples of spacecraft materials are done for a variety of lighting and photometer viewing angles. The resulting reflectivity values are presented as a function of two pairs of angles θ_1, ϕ_1, and θ_2, ϕ_2. This report describes a digital computer program that computes the θ, ϕ pairs necessary to utilize bidirectional reflectivity data for determining relative brightness of points on the exterior of the Apollo launch vehicle. The computations are made for a given vehicle attitude, direction of the sun or other single illumination source, and observer line-of-sight (LOS), all with respect to a fixed coordinate system, East, North and up. Author

N69-14865# Academy of Sciences (USSR), Moscow.
ON THE STABILITY OF MOTIONS OF THE RIGID BODIES WITH CAVITIES, CONTAINING LIQUID
V. V. Rumjantsev 1968 21 p refs Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

A method of investigating non-linear stability motion of solid bodies with liquid filled cavities is considered. Two approaches are envisaged, both relying on Lyapunov's theories: one considered cavities completely filled with liquid, the other the stability of motion with respect to a part of the variable, by considering chiefly the motion of the liquid. Results are applied to the stability of steady motion and a rigid body with a simply constructed cavity filled with an ideal liquid is considered. ESRO

N69-14867*# Informatics, Inc., Los Angeles, Calif.
FORTRAN OPTICAL LENS DESIGN PROGRAM. VOLUME 1: MATHEMATICAL SPECIFICATIONS
Paul J. Firnett and Leslie A. Wilson 1 Oct. 1968 152 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951495)
(NASA-CR-94323; JPL-TR-67-700-10-2-Vol-1) Avail: CFSTI CSCL 20F

Geometry, ray specification and tracing, system characteristics, computation and display of spot diagrams, sensitivity analysis, and cross sectional plotting are described for FOLDP, FORTRAN Optical Lens Design Program. A digital computer program written in 7094 FORTRAN IV source language. FOLDP uses the principles of geometric optics to automatically design optical systems and can handle systems containing up to 100 surfaces, seven objects points, six colors, and 200 rays. M.W.R.

N69-14868*# Informatics, Inc., Los Angeles, Calif.
FORTRAN OPTICAL LENS DESIGN PROGRAM. VOLUME 2: USER'S MANUAL
Paul J. Firnett and Leslie A. Wilson 1 Oct. 1968 203 p Prepared for JPL
(Contracts NAS7-100; JPL-951495)
(NASA-CR-94311; JPL-TR-67-700-10-2-Vol-2) Avail: CFSTI CSCL 20F

A user's manual is presented on the Fortran optical lens design program. A description of the output type and content is given along with an explanation of how to set the case deck. Particular emphasis is placed on the input description, and the organization and content of a case deck is summarized. Examples are given in order to demonstrate the capabilities of the program. B.S.D.

N69-14869*# Informatics, Inc., Los Angeles, Calif.
FORTRAN OPTICAL LENS DESIGN PROGRAM. VOLUME 3: PROGRAM ORGANIZATION AND DESCRIPTION
Paul J. Firnett and Leslie A. Wilson 1 Oct. 1968 545 p Prepared for JPL
(Contracts NAS7-100; JPL-951495)
(NASA-CR-94313; JPL-TR-67-700-10-2-Vol-3) Avail: CFSTI CSCL 11F

Implementation of a model into a computer program is shown in a detailed description of the organization and structure for the FORTRAN optical lens design program. The overlay diagram is presented and the characteristics of each of the subroutines are discussed. Interlink and intralink aspects of labeled common are detailed, as are links 0 to 8 of the program. A section of program modification covers adding capability, adding new input, changing

the dimensions of E and conversion problems. The storage map shown is essentially an overlay diagram with storage requirement information, and a source program listing is included. M.W.R.

N69-14938# European Space Research Lab., Noordwijk (Netherlands).
SCIENTIFIC RESEARCH AT THE EUROPEAN SPACE RESEARCH LABORATORY
V. Manno, D. E. Page, A. Pedersen, W. Steinmann, and E. A. Trendelenburg *In its* ESRO/ELDO Bull. No. 2 Aug. 1968 p 4–10 (See N69-14937 04-34)
Avail: CFSTI

One year's scientific research activities in the particle, ionospheric and surface physics fields are reviewed. A polar cap absorption experiment; an experiment proposed for the HEOS A-2 satellite to measure electrons, protons and alpha particles; work on a channel electron multiplier and plasma accelerator as well as an experiment for optical studies in the vacuum UV, under ultra-high-vacuum conditions are summarized. ESRO

N69-14947# Southampton Univ. (England). Inst. of Sound and Vibration Research.
INSTITUTE OF SOUND AND VIBRATION RESEARCH; UNIVERSITY OF SOUTHAMPTON Annual Report, Period Ending Jun. 1968
Jun. 1968 154 p refs
Avail: Issuing Activity

This report contains project summaries and some results of work by the following groups of the institute: (1) acoustics; (2) audiology and human factors; (3) fluid dynamics and instrumentation; (4) industrial noise, vibration, and general environmental engineering; and (5) structures. Also presented is a Director's Report on the year's activities as well as information on courses offered at the institute, conferences, symposia, publications, and personnel. K.W.

N69-14959# Sud-Aviation, Cannes (France).
SIMULATION OF MAGNETIC MATERIALS [LA SIMULATION DES MATERIAUX MAGNETIQUES]
M. Calvaire 1968 11 p In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

Mathematical models for the behavior of ferromagnetic materials submitted to magnetization and demagnetization, and some applications to the stabilization of EOLE project are presented. Devices for measuring the magnetic moment are discussed. ESRO

N69-14997# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
SOME REMARKS ON THE SYMMETRY PROPERTIES OF NONLINEAR OPTICAL SUSCEPTIBILITIES
N. Bloembergen Aug. 1968 23 p refs
(Contract N00014-67-A-0298)
(AD-677037; TR-569) Avail: CFSTI CSCL 20/6

The intrinsic symmetry properties associated with a nonlinear polarization which is a quadratic or cubic function of the electric field amplitudes are briefly reviewed. Some simple examples illustrate the polarization properties of second and third harmonic generation, the sum and difference frequency mixing, in both cubic and isotropic non-absorbing materials. Particular attention is given to the case of circular polarized light beams propagating along an axis of symmetry. A few remarks are made on the situation in dissipative media, including the polarization dependence of the stimulated Raman effect. Author (TAB)

N69-15000# Michigan Univ., Ann Arbor. Radiation Lab.
ITERATIVE SOLUTIONS OF MAXWELL'S EQUATIONS
John S. Asvestas (Ph.D. Thesis) Oct. 1968 89 p refs
(Contract F19628-68-C-0071)
(AD-677006; AFCRL-68-0495; SR-2) Avail: CFSTI CSCL 20/14

The problem of scattering of electromagnetic waves by a closed, bounded, smooth, perfectly conducting surface immersed in vacuum is considered and a method for determining the scattered electric and magnetic field vectors (solutions of the homogeneous Maxwell equations satisfying the well known boundary conditions on the surface and the Silver-Muller radiation condition at infinity) everywhere exterior to the surface is presented. Specifically, two integral equations are derived, one for each scattered field vector. These equations are coupled. The kernels of the equations are dyadic functions of position and can be derived from the solutions of standard interior and exterior potential problems. Once these dyadic kernels are determined for a particular surface geometry the integral equations can be solved by iteration for the wave number k being sufficiently small. Alternatively, the scattered fields in the integral equations may be expanded in a power series of the wave number k and recursion formulas be found for the unknown coefficients in the expansions by equating equal power of k. As a check, the method is applied to the problem of scattering of a plane electromagnetic wave by a perfectly conducting sphere. The first two terms in the low frequency expansions of the electric and magnetic scattered fields are found and are shown to be in complete agreement with known results. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N69-13901 California Univ., Riverside.
NUCLEAR MAGNETIC RESONANCE IN INDIUM METAL POWDER AT 4.2°K
James Ewing Adams, Jr. (Ph.D. Thesis) 1968 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-4917

Nuclear magnetic resonance has been observed in indium metal at 4.2°K over a magnetic field range of 15 to 30 kG. The isotropic and anisotropic Knight shifts were evaluated at twelve different magnetic field points with the mean result that $k = 0.0080 \pm 0.0002$; $a = -0.0005 \pm 0.0002$. The quadrupolar coupling constant was evaluated at 16 different field points in the same range and was found to be $\nu_Q = 1.885 \pm 0.002$ Mc/sec. No magnetic field dependence in either the Knight shifts or the quadrupolar coupling constant was observed. A technique is discussed for taking into consideration the effect of Gaussian broadening on the asymmetrically quadrupolar broadened power absorption curve. The detection was accomplished with a conventional marginal oscillator. Dissert. Abstr.

N69-13906 Stanford Univ., Calif.
PART 1. STATISTICAL THERMODYNAMICS OF SMALL MOLECULES AND THEIR MIXTURES. PART 2. EFFECT OF INTRAMOLECULAR INTERACTION ON MACROMOLECULAR CONFIGURATION IN DILUTE SOLUTION
Stephen Fisk (Ph.D. Thesis) 1967 136 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-6418

A partition function for the liquid state is derived assuming the liquid may be approximated by a system of hard particles in a uniform mean attractive field. The mean attractive potential is then to be inversely proportional to the volume of the system.

Three characteristic parameters are obtained from the experimental density ρ, thermal expansion coefficient α, and thermal pressure coefficient γ. Values of ρ, α, and γ are measured and reported for nitromethane and acetonitrile. The theory is extended to binary liquid mixtures, non-random mixing being introduced by means of a quasi-chemical approximation. For mixtures of a polar molecule with a non-polar component, agreement between theoretically derived excess thermodynamic quantities and those reported in the literature is quite poor. Discrepancies are analyzed, and it is found that agreement between theory and experiment is best for those systems whose polar component has a dipolar contribution to the intermolecular pair potential which is small relative to the contribution of dispersion interactions. Dissert. Abstr.

N69-13908 Purdue Univ., Lafayette, Ind.
REACTIVE COLLISIONS AND INTERMOLECULAR POTENTIALS FROM SCATTERING DATA
Ronald Earl Olson (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-6338

An iterative mapping procedure was developed which correlates variations in the scattering phase shifts to intermolecular potential changes. An iterative inversion technique coupled with the two state theory to obtain the He-He + ground state and first excited state potentials from the 10 and 15 eV experimental differential cross sections. A modification of the inversion method was applied to the 3.68, 7.34, 10.99, and 18.31 eV Li+-He relative elastic differential cross sections. Four intermolecular potentials were obtained which showed good correlation among one another. The average inversion potential displayed satisfactory agreement with existing clustering and mobility data. A two state theory coupled with a distorted wave formulism was applied to K+HBr, K+TBr, and K+Br_2 reactive collisions. The model utilizes a curve crossing technique for transfer between states. Calculations employ spherically symmetric potentials of the reactants and products along with their asymptotic energies. Nonzero quantum extrema are observed on the reactive differential cross sections.

N69-13914 Wisconsin Univ., Madison.
ON THE ANALYTIC SOLUTION OF THE SCHROEDINGER EQUATION FOR THE TWO-ELECTRON ATOM
Ronald Joseph White (Ph.D. Thesis) 1968 282 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 68-5368

The Schrödinger equation for the ground state of the two-electron atom is examined in detail and a technique is introduced by means of which an analytic solution may be realized. The technique, which may be called a partial series expansion method, consists of assuming a series form for the wavefunction in powers of the interelectron separation with coefficients which are functions of two variables and of determining the coefficients so that a satisfactory solution of the Schrödinger equation results. The coefficients are related by first order differential recursion relations which may be integrated explicitly. The method is not complete because the initial coefficient independent of the interelectron separation, is undetermined. The extension of the method to the hydrogen molecule and the two-electron atom in the presence of a uniform electric field is also considered. Dissert. Abstr.

N69-13921 Columbia Univ., New York.
CALCULATION OF NON-RETARDED AND RETARDED VAN DER WAALS FORCES AND OF NUCLEAR SPIN-SPIN COUPLING CONSTANTS
Paula Mayer Getzin (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms: HC $7.00/Mirofilm $3.00 Order No. 68-5592

Retarded and nonretarded van der Waals interactions were calculated for certain simple two and three body systems in a given configuration. The systems included combinations of hydrogen and helium atoms, helium + ions, and hydrogen molecules. A new analytic expression for the frequency-dependent polarizability of the hydrogen atom and of one electron ions was obtained, while previously derived expressions were used for the polarizabilities of the other species. It is concluded that retardation is a nonnegligible effect at moderate separations of many atoms and molecules. An attempt was made to calculate the nuclear spin-spin coupling constants of hydrogen deuteride and of hydrogen fluoride. The variation-perturbation method was used, and three different types of trial functions examined. Dissert. Abstr.

N69-13925 Texas Univ., Austin.
LEVEL STRUCTURE IN O 15 FROM THE PROTON BOMBARDMENT OF N14
Martin Luther West, II (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-4360

Absolute differential cross sections for the elastic and inelastic scattering of protons by ^{14}N have been measured at laboratory angles of 67.5, 85.9, 105.8, 123.7, 135.0, and 157.5 degrees for bombarding energies between 3.7 and 5.7 MeV. In addition, angular distributions have been measured at 21 selected energies. Thirteen resonances were observed in the elastic scattering cross section. An attempt has been made to fit these data using a multi-level R-matric approximation. A computer code based on the R-matrix two-level approximation has been writen for calculation of the elastic cross sections. Extensive computations have been performed with this code using the inelastic data as an aid in choosing trail resonance parameters. Unfortunately, it has not been possible to produce an exact fit to the data due to uncertainties in the off-resonance background. This background is usually assumed to be of the hard-sphere type, which gives rise to a set of adjustable spin-independent potential phase shifts. Dissert. Abstr.

N69-13929 California Univ., Berkeley.
CHARACTERISTIC OXYGEN K-SHELL X-RAY PRODUCTION IN THIN FILMS OF ALUMINUM OXIDE BY 20- TO 100-keV PROTONS
Ronnie Ray Hart (Ph.D. Thesis) 1967 48 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-5732

The stopping power of aluminum oxide and the oxygen K-shell X-ray production cross section for 20- to 100-keV protons were determined by measurements of the oxygen-K X-ray yield (x rays/proton) from thin films of aluminum oxide, which were formed on aluminum substrates by anodic oxidation. The stopping power data has a standard deviation of less than 10% and has maxima at proton energies of 65 keV and 90 keV, corresponding to peaks in the stopping powers of aluminum and oxygen. Since self-supporting thin films were not required, this technique may enable more measurements of stopping powers in the low energy proton range. The measurements of the X-ray production cross section for the K-shell of oxygen have a standard deviation of less than 7% and are consistent with previous measurements of the carbon and magnesium K-shell X-ray production cross sections. Dissert. Abstr.

N69-13934# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
MEASUREMENT OF THE PHOTON TO ALPHA RATIO FOR PLUTONIUM ISOTOPES
K. L. Swinth *In its* Ann. Rept. for 1967 to the USAEC Div. of Biol. and Med., Vol. 2, Pt. 1 Jun. 1968 p 20-28 refs (See N69-13931 04-14)
Avail: CFSTI

Accurate use of either the L X-rays from decaying plutonium isotopes or the 60 keV ^{241}Am gamma ray in making health

physics or radiochemical determinations depends in part on a knowledge of the specific activity and/or isotopic composition of the materials. Specific activities, i.e., X-rays/α, gamma/α, etc. however, vary with isotopic composition which is not always known. This paper discusses the development of techniques for the sensitive measurement of the X/α ratio to be used in comparing and/or evaluating the radiological hazard and isotopic composition of plutonium sources. Two systems, a proportional counter-scintillation counter combination and a solid state arrangement, are described and evaluated. Author (NSA)

N69-13935# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
DEPENDENCE OF PLUTONIUM X-RAY COUNTING ON ISOTOPIC COMPOSITION
K. L. Swinth *In its* Ann. Rept. for 1967 to the USAEC Div of Biol. and Med., Vol. 2, Pt. 1 Jun. 1968 p 29-38 refs (See N69-13931 04-14)
Avail: CFSTI

Plutonium materials may often be analyzed by counting the low energy photons emitted (17 keV X rays, 60 keV ^{241}Am gamma). Since the specific activity and the yield of X rays vary among the plutonium isotopes and ^{241}Am, and plutonium samples differ in isotopic composition, difficulties arise during analysis of the amount of plutonium present or of the alpha particle activity (dose rate). Calculations explored the changes in X-ray and γ-ray activity of plutonium with isotopic composition and time. For a source containing 90% ^{239}Pu by weight, 55% of the total X-ray activity results from the ^{239}Pu, but this falls to 27% after a 5 yr decay. This change with time results mainly from the decay of ^{241}Pu to ^{241}Am. A typical source containing 94% ^{239}Pu and 0.08% ^{241}Am by weight has a calculated X/α ratio of 0.063 and a 60 keV gamma/α ratio of 0.013. This paper discusses the problems and the experiments pertaining to a number of different isotopic compositions which relate to the maximum permissible body burden (MPBB) for the material. Author (NSA)

N69-13951 New Mexico Univ., Albuquerque.
THE U^{233} FISSION AND CAPTURE CROSS SECTIONS AND THEIR ANALYSIS AT LOW ENERGIES
Delmar Wesley Bergen (Ph.D. Thesis) 1967 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-5547

The ^{233}U fission and capture cross sections were measured using a nuclear-device neutron source and time-of-flight techniques. Cross section data are presented from 20 to 10^6 eV for fission and from 20 to 63 eV for fission + capture. The resonance region (20 eV to 63 eV) was fitted with both a single level function consisting of a sum of Breit-Wigner levels and the Reich and Moore multilevel function based on R matrix theory. The resulting resonance parameters are listed and discussed. In order to establish the validity of the resonance parameters derived from the multilevel fit, a study is presented of the cross section derived from two and three hypothetical resonances under various conditions and of the cross sections obtained from randomly generated resonances. Dissert. Abstr.

N69-13962 Kent State Univ., Ohio.
SOLUTION OF THE ONE-DIMENSIONAL SCHROEDINGER EQUATION BY THE METHOD OF CONTINUED FRACTIONS
Lee E. Vescelius (Ph.D. Thesis) 1967 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-6222

It is pointed out that there is a set of potential functions which yield exact solutions to the Schroedinger equation but which have never been investigated because of the computational difficulties involved. The Schroedinger equation is solved for two potential functions which lead to a three term recursion formula for the coefficients of a power series solution. The energy levels are obtained by finding the roots of a continued fraction generated from the recursion formula. The computational difficulties of this procedure are overcome by the use of a digital computer. The two potential functions discussed are applied to problem of anharmonic vibrations of polyatomic molecules. Dissert. Abstr.

N69-13962 Colorado Univ., Boulder.
NEGATIVE PION PLUS P ELASTIC SCATTERING AT 1.7 BeV/c
Donald Dale Allen (Ph.D. Thesis) 1967 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2667

The elastic differential scattering cross section from 1.7 BeV/c negative pions on protons is studied. The forward peak is analyzed in terms of a purely optical diffraction mechanism which gives information about the size of the interaction radius. The data exhibit a second maximum at $\cos\theta^*_{\pi^-} = 0.05$ in the barycentric system which corresponds to a four momentum transfer of 1.19 $(BeV/c)^2$. An analysis of the elastic differential scattering cross section is discussed in terms of three models: (1) A purely absorptive model where it is assumed that all partial waves up to L=4 are absorbed; (2) A modification of the absorptive model to take into account nonabsorptive and spin flip contributions; and (3) A model which consists of purely absorptive and spin dependent contributions (which includes a spin flip term). It is found that the purely absorptive model (1) fits the data in the forward peak but is poor at the larger scattering angles. The other two models give much better fits over the entire range of scattering angles. By comparing the two fits from models (2) and (3), the relative importance of the nonabsorptive and spin flip contributions over various angular regions is determined. Dissert. Abstr.

N69-13967 Cornell Univ., Ithaca, N. Y.
ELECTRON SPIN RESONANCE AND OPTICAL STUDIES OF HYDROXIDE-DOPED SODIUM FLUORIDE: THE EFFECTS OF IMPURITIES ON COLOR CENTER FORMATION
Marvin Lawrence Meistrich (Ph.D. Thesis) 1967 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-4679

A marked sample dependence was observed which indicated an impurity-dominated effect. Experiments were undertaken to understand the states and reactions of the impurities in order to clarify their role in the color center reactions. The studies were confined to NaF and, in general, to oxygen and oxygen-containing impurities such as OH^-. Room temperature X-ray coloration of NaF was studied, and it was found that the *purest* samples show *almost no* color center formation. The level of color center formation in these samples was always less than the impurity concentration. An investigation of oxygen-containing anions in the NaF lattice identified the infrared absorption band due to the substitutional OH^- at 3728 cm^{-1}, with a width of about 30 cm^{-1} at room temperature. The ultraviolet transition of the U-center (substitutional hydride ion) has been identified at 8.0 ev. The reactions and changes in state of these impurities upon X-irradiation were monitored by the magnetic resonance and optical spectra. In addition, the state of oxygen in NaF doped with Na_2O_2 was discussed. The oxygen was probably present at $O^=$. Several unidentified spin resonance patterns always observed in X-irradiated oxygen containing NaF were studied. Their possible association with color centers or oxygen ions was considered. Dissert. Abstr.

N69-13988 Indiana Univ., Bloomington.
NUCLEAR SPIN CONVERSION AND VIBRATION-ROTATION SPECTRA OF MATRIX-ISOLATED METHANE
Franklin Howard Frayer (Ph.D. Thesis) 1967 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-2291

The ν_3 and ν_4 infrared spectra of methane suspended in solid argon at 4°K are presented. The assignment of vibration-rotation features enables the methane rotational levels to be determined. The spacings of these levels suggest that methane

is a hindered rotor in its solid matrix. A model for a rotating tetrahedron in a cubic crystal agrees qualitatively with the experimental results. The Pauli principle places severe restrictions on the nuclear spin states possible for rotational energy levels in molecules with identical nuclei. Observed time-dependent absorption changes for CH_4 in argon are evidence of nuclear spin conversion and follow first order kinetics with a halflife of 90 minutes. Spin conversion in the absence of paramagnetic impurities occurs because spin-rotation interaction in methane mixes different spin-state wave-functions. The halflife is unchanged by the addition of up to 1% N_2 to the matrix but decreases to 3 minutes with only 0.2% O_2. The catalysis is due to the large paramagnetic moment of oxygen which perturbs the spin states. The interaction of methane-oxygen affects the conversion in a matrix even when pairs are separated by many argons. The spin changes are reversible, and upon lowering the temperature go to a new equilibrium value. Dissert. Abstr.

N69-13971# Atomic Energy Commission, Oak Ridge, Tenn.
THE USE OF SMALL ACCELERATORS FOR TEACHING AND RESEARCH
10 Apr. 1968 447 p refs Presented at Oak Ridge, Tenn., 8–10 Apr. 1968
(CONF-680411) Avail: CFSTI

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N69-13976# Arkansas Univ., Fayetteville.
EXPERIMENTS WITH THE UNIVERSITY OF ARKANSAS 400 kv POSITIVE ION ACCELERATOR
J. L. Meason *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 82–96 refs (See N69-13971 04-24)
(Contract AT(40-1)-3235)
Avail: CFSTI

The University of Arkansas 400 KV Positive Ion Accelerator is operated about 90% of the time for the production of 14–15 MeV neutrons through the well known DT reaction. One of the recent works performed in connection with the University of Arkansas accelerator was the discovery of a new gold isotope, Au^{204}, and a study of the decay of Au^{202}. Irradiation of Hg^{204} with 14.8 MeV neutrons was found to produce the new nuclide through the $Hg^{204}(n,p)Au^{204}$ reaction. The following radiation characteristics have been observed to belong to the decay of Au^{204}: half-life, 4.0±1.0 seconds; beta end-point energy, 4.5±0.3 MeV; gamma-ray energy, 0.43±0.01 MeV. Au^{202} was produced through the reactions $Hg^{202}(n,p)Au^{202}$ and $Tl^{205}(n,\alpha)Au^{202}$. The half-life of this nuclide was determined to be 30±3 seconds. The beta end-point energy of 3.5±0.2 MeV and gamma-rays of 0.44±0.01 and 0.52±0.02 MeV were observed to belong to the decay of Au^{202}. The relative intensities of gamma-rays were measured to be 100 and 2.5±1, respectively. Author

N69-13978# Georgetown Univ., Washington, D. C.
MULTIPARTICLE BREAKUP REACTIONS BELOW 1 MeV
James M. Lambert and Paul A. Treado *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 208–220 ref (See N69-13971 04-24)
Avail: CFSTI

A number of experiments are being carried out on nuclear systems having three particles in the final state. One of the primary features of these reactions is that they almost invariably go through a sequential decay process in which a short-lived, composite, unstable nucleus is emitted which then decays in flight (e.g., ^8Be and ^5He). When these particles decay from a definite energy state, the reaction kinematics are completely determined if two of the

particles are detected in coincidence and with energy analysis. A discussion of sequential, three-body kinematics will be given, including transformations to the initial center-of-mass and to the center-of-mass of the composite nucleus. The question of transforming cross sections from these center-of-mass systems to the laboratory system will also be examined. Author

N69-13979# South Carolina Univ., Columbia.
REACTIONS AND SCATTERING OF He-3 USING A LOW ENERGY ACCELERATOR
R. D. Edge and W. F. Lankford *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 221-240 refs Supported by NSF (See N69-13971 04-24)
Avail: CFSTI

The use of He^3 to induce reactions involving the emission of gamma rays, neutrons, protons, deuterons and alpha particles from nuclei of mass up to that of oxygen will be discussed. Specifically, the experimental requirements, such as the resolving magnet for the particle beam, use of doubly charged He^3, the scattering chamber, detectors, electronics and analysis of results will be mentioned, together with possible theoretical interpretations in the light of the compound nucleus model, stripping, and sequential decay. Some possible experiments involving a comparison of the Coulomb excitation of low energy states in light nuclei with both He^3 and He^4 will also be discussed. Author

N69-13980# Ohio Univ., Athens. Physics Dept.
NEUTRON TIME-OF-FLIGHT TECHNIQUES
R. W. Finlay and C. E. Brient *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 241-260 Supported by NSF (See N69-13971 04-24)
Avail: CFSTI

On large and popular class of experiments which can be performed using a very low energy accelerator is that group of experiments in which the energy of the outgoing neutron is measured. The technique for measuring neutron velocity (and therefore neutron energy) which is most readily adapted to very low energy accelerators is the neutron time-of-flight technique. The main emphasis of this paper will be to review the basic principles of time-of-flight measurements and to describe several types of experiments which can be done by using this versatile technique. Author

N69-13981# Haverford Coll., Pa.
NUCLEAR SPECTROSCOPY
Fay Ajzenberg-Selove *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 261-271 refs Supported by NSF (See N69-13971 04-24)
Avail: CFSTI

Outlined are nuclear spectroscopic studies of nucleic structures with emphasis on the $^9Be(t,\alpha)^8Li$ reaction (Q_m =2.93 MeV). Besides the ground state of ^8Li and the known excited states at E_x=0.98 and 2.26 MeV, the spectra clearly show a state at E_x=6.532 ± 0.25 MeV. Magnetic spectrographs are used to determine the momenta of charged particles. G.G.

N69-13983# Nuclear-Chicago Corp., Des Plaines, Ill.
LOW ENERGY PROTON SCATTERING FROM CRYSTALS
W. White, R. M. Mueller, and C. S. Barrett (Chicago Univ.) *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 300-305 refs (See N69-13971 04-24)
Avail: CFSTI

Protons and other heavy charged particles of initial energies in the 100 keV range produce patterns characteristic of crystal structure when backscattered from crystals. These patterns, commonly referred to as blocking patterns, are the result of a blocking effect exerted by the crystal structure on backscattered particles such that intensities are suppressed in directions of rows and planes of atoms at lattice sites. The resultant pattern of white spots and lines, as recorded on nuclear emulsion film, is a linear (gnomonic) projection of directions and planes respectively of the crystal. Common fcc and bcc metals, and diamond cubic semiconductors have been studied by the blocking method. Each shows a characteristic pattern of 9 or more differently indexed sets of lines whose intensities may be ordered in sequences which correlate with crystal structure. Applications of the method to surface and bulk studies are discussed. The problem of the measurement of energy loss at very low energies is also discussed and a method proposed for the measurement of atomic particle stopping cross sections as a function of direction in a crystal. Author

N69-13984# Bell Telephone Labs., Inc., Murray Hill, N. J.
PARTICLE CHANNELING EXPERIMENTS USING SMALL ACCELERATORS
W. M. Gibson *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 306-389 refs (See N69-13971 04-24)
Avail: CFSTI

The purpose of this report is to review the various topics concerned with current activity and interest in particle channeling studies and applications. An attempt is made to do this in sufficient detail to show the relationship between these topics and their relevance to current particle channeling theory. The discussion is slanted toward experimentalists and particularly toward the users of low energy accelerators. This puts no important restriction on the scope of the discussion but does influence the emphasis. Extensive (although not comprehensive) reference is made to the published literature and techniques associated with each topic are emphasized with an attempt made to point out areas of technical or analytical difficulty. Author

N69-13985# Oak Ridge National Lab., Tenn.
ATOMIC AND MOLECULAR COLLISION PHYSICS WITH LOW ENERGY ACCELERATORS
C. F. Barnett *In* AEC The Use of Small Accelerators for Teaching and Res. 10 Apr. 1968 p 415-425 refs Supported by AEC (See N69-13971 04-24)
Avail: CFSTI

During the past several years a 600 keV accelerator has been used to study atomic collision processes in support of the thermonuclear effort at the Oak Ridge National Laboratory. Knowledge of absolute collisional cross sections is needed to understand both the creation and the loss processes occurring in high temperature plasmas. Probably of more importance is the use of atomic collision phenomena to diagnose plasma parameters such as temperature and life-times. Today, I wish to describe three typical experiments that illustrate the diversity of small accelerators in studying molecular physics, and collisions occurring in the gaseous phase or at metallic surfaces. Author

N69-14004 New York Univ., N. Y.
ATOMIC HYDROGEN SURFACE RECOMBINATION STUDIES
Alexander Ernst Mandl (Ph.D. Thesis) 1967 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-6084

Studies were made on the surface recombination of atomic hydrogen in the afterglow of an rf discharge by observing the resonant absorption of radiation at the atomic hydrogen hyperfine frequency (1420 Mc/sec). Large-volume sealed bottles filled with reagent-grade hydrogen and hydrogen-rare gas mixtures in the pressure range of 0.8 to 15 mm Hg were placed directly within the cavity of a 1420 Mc/sec magnetic-resonance spectrometer and subjected to a pulsed 7 Mc/sec electrodeless discharge at a repetition rate of typically 1.5/sec. The efficiency of the 1st-order

recombination process (the surface recombination coefficient, γ) was measured on glass and quartz surfaces (with various surface treatments) which were exposed to an rf discharge. Values of γ between 5.5×10^{-5} and 56×10^{-5} were found for various surfaces. Values of γ varied, however, by as much as a factor of 3-1/2 for different bottles of the same material with the same surface treatment. A limited investigation of the effect of water on the efficiency of hydrogen dissociation and of the effect of water on the surface recombination coefficient was also carried out. Dissert. Abstr.

N69-14027# Argonne National Lab., Ill.
INTERFERING RESONANCES
P. A. Moldauer Jul. 1968 16 p refs
(Contract W-31-109-ENG-38)
(ANL-7467) Avail: CFSTI

Unresolved resonances are discussed for the case in which resonances of the same angular momentum in a single isotope have widths whose magnitudes approach and eventually exceed the spacings of such resonances. The cross section behavior is dominated by resonance interference. It is shown that even the values and relations among resonance parameters are dominated by interference effects. NSA

N69-14030 Iowa State Univ. of Science and Technology, Ames.
ON THE EFFECTS OF SPIN, SYMMETRY, AND POLARIZATION WHEN AN ISOSINGLET RESONANCE DECAYS TO FOUR PIONS
Terence John Nelson (Ph.D. Thesis) 1967 62 p Supported in part by NSF
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-2846

Phase-space distributions for the decay of an isosinglet resonance into four pions are developed. Such resonances have been observed in the final state of the reaction $p+p\rightarrow2\pi^{+}2\pi^{-}+\pi^{0}$, for example. Of primary interest are the spin and parity of the resonance. States of four pions that observe Bose statistics and have zero isotopic spin divide into two symmetry types. The distributions are developed phenomenologically from the simplest possible T-matrix for each parity and symmetry type for spins zero and one. In general, eight variables characterize the four-particle decay problem. To facilitate the experimental determination of the spin, parity, and symmetry type, partial integrations of the distributions are performed analytically. Dissert. Abstr.

N69-14041 California Univ., Berkeley.
RADIATIVE LIFETIMES OF ATOMIC CESIUM AND MOLECULAR IODINE
Richard James Wolff (Ph.D. Thesis) 1967 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-5848

An apparatus is described that is capable of measuring radiative lifetimes for energy levels that can be reached in absorption. The sample (solid, liquid, or gas) is excited into the level of interest by the appropriate resonance radiation, the exciting light is removed in 18 nsec, and the fluorescence is photoelectrically observed. By using photon counting and sampling techniques, a decay curve is built up in a multichannel memory. Presently, lifetimes in the range 15 nsec to 5 μsec can be measured, but this range can be extended in both directions. Experimental results for some levels in the B $^{3}\Pi_{0}+_{u}$ state of molecular iodine are presented; no large scale variations of the lifetime with the B state vibrational level are found. Measurements of the lifetime of the 7p $^{2}P_{3/2}$ state of atomic cesium give 111±6 nsec. This result is in moderately good agreement with one previous determination and with a Bates-Damgaard calculation. The lifetime of the 3p ^{2}P states of atomic sodium is found to be 16.1±1 nsec which agrees excellently with other measurements. Dissert. Abstr.

N69-14052 California Univ., Berkeley.
BOUNDS FOR THE CORRECTION TO THE BORN TERM AND APPLICATIONS TO p-p SCATTERING FOR A GENERALIZED DISPERSION MODEL
Judith Binstock (Ph.D. Thesis) 1967 41 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-34

The unitarizing corrections to the Born term are shown to be bounded above and below. The bounds follow from the mathematical forms of the models, to all of which forms a theorem applies. The correction bounds are given for several p-p amplitudes for the range 0 to 300 MeV. The results are shown to explain why the apparently different models mentioned above give similar Born terms after subtraction of the correction from the experimentally determined (p-p) amplitude. A generalization of these models for the unitarizing correction is proposed, which has properties leading to partial-wave dispersion relations, and which has a specified relationship between the asymptotic behavior and the fluctuation of the sign of the left-hand discontinuity. Upper and lower bounds are found for the correction term prescribed by this generalized model (which is not restricted, in its application, to nucleon–nucleon scattering). Dissert. Abstr.

N69-14061# Oak Ridge National Laboratory, Tenn. Neutron Physics Div.
TIME-DEPENDENT NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN AN AIR-OVER-GROUND GEOMETRY. VOLUME 2: TABULATED DATA
E. A. Straker Sep. 1968 529 p refs Supported by DASA
(Contract W-7405-eng-26)
(ORNL-4289-Vol-2) Avail: CFSTI

The tabulated results of Monte Carlo and discrete ordinates calculations of neutron fluxes and doses and secondary gamma-ray fluxes and doses resulting from an isotopic neutron source located 50 ft above the ground surface are presented. Sources of various energies up to 15 MeV are considered, and in addition the sources are folded together to simulate a fission source. The Monte Carlo data are tabulated as time-energy and time-dose distributions integrated over angle and as time-angle distributions integrated over energy for ranges from the source up to approximately 1500 meters. The discrete ordinates data are tabulated as energy spectra and as angular dose at the various ranges, and also as angular distributions of the thermal, intermediate, fast, and total neutron flux and of the low, high, and total gamma-ray flux. Author (NSA)

N69-14066 Yale Univ., New Haven, Conn.
A MEASUREMENT OF THE FINE AND HYPERFINE STRUCTURE IN THE 2 3P STATE OF HELIUM
Charles Edward Johnson (Ph.D. Thesis) 1967 230 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 68-5164

A measurement of the fine and hyperfine structure in the (1s,2p) ^{3}P state of helium was made using the optical-microwave atomic beam magnetic resonance method. The 2 $^{3}P_{1}$–2 $^{3}P_{2}$ fine structure separation of He^{4} was obtained from a measurement of the ($J=1, m_{J}=0$) to ($J=2, m_{J}=0$) transition frequency at a magnetic field of approximately 500 gauss. Dissert. Abstr.

N69-14083 Vanderbilt Univ., Nashville, Tenn.
POLES AND RESONANCES IN ETA PRODUCTION
Stanley Roderick Deans (Ph.D. Thesis) 1967 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-5413

The purpose of this thesis is to study eta production by photons and pions on nucleons within the framework of a pole and resonance model. We want to know whether a satisfactory explanation of available data on eta production up to several hundred MeV above threshold can be found with such a model. We

hope to find the magnitude of the eta-nucleon coupling constant, and determine just which resonances paly important roles in eta production. Special attention is given to the relation of the findings to unitary symmetry models. We calculate the pole contributions to production amplitudes by Feynman rules. The resonance contributions in the direct channel are expressed by Breit-Wigner forms for the multipole and partial-wave amplitudes. Some of these calculations are shown in detail. Dissert. Abstr.

N69-14085 Vanderbilt Univ., Nashville, Tenn.
ANTIISOBAR PRODUCTION IN ANTIPROTON-DEUTERON INTERACTIONS AT 2.8 GeV/c
Thomas Brackenridge Cochran (Ph.D. Thesis) 1967 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-5411

The deuterium filled 20-inch bubble chamber at the BNL-AGS was exposed to a 2.8 GeV/c antiproton beam. The results presented are based on 40,000 pictures. An analysis of approximately 17,000 three and four prong event topologies yielded 1132 events which fit the reaction $\bar{p}n(p_s) \rightarrow \bar{p}\pi^- p(p_s)$, where (p_s) is the proton in the deuteron which behaves as a spectator to the $\bar{p}n$ interaction. In the final state (p_s) is taken to be the slower of the two protons. A study was made of the impulse approximation which assumes that the spectator proton does not enter into the $\bar{p}n$ interaction. The reaction is observed to take place 94 percent of the time through production of the $p\pi^-(3,3)$ antiisobar in predominantly peripheral interactions. The measured total cross section for the reaction $pn \rightarrow \bar{N}^* - \bar{p}$ is 3.79 ±0.17 mb. Dissert. Abstr.

N69-14090 California Univ., San Diego.
MAGNITUDE AND SIGN OF THE NEUTRAL K_1^0-K_2^0 MASS DIFFERENCE
Susarla Suryanarayana Murty (Ph.D. Thesis) 1967 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 67-15851

The purpose of this investigation is to study the magnitude and sign of the mass difference $\delta = M_{K_2^0} - M_{K_1^0}$, where K_1^0 and K_2^0 are superpositions of the neutral K^0 and $\bar{K}^0$ mesons. The method used to investigate this consists in producing a K^0 beam, by charge exchange of a K^+ beam, at time zero. The K^0 beam, after a certain time, passes through a stainless steel regenerator. At the exit of the regenerator, the beam contains the originally produced but attenuated K_1^0 beam and a K_2^0 regenerated K_1^0 beam. The phase of these two waves depends on the distance from the source to the regenerator, multiplied by the mass difference, δ. The interference effects of the common decay mode $(\pi^+ + \pi^-)$ have been studied, by varying the distance between the source and the regenerator, and have obtained the following results: (1) proof that the two waves decay into quantum mechanically identical states: (2) the magnitude of the mass difference is +0.45 ±0.02, and (3) K_2^0 is heavier than K_1^0. Dissert. Abstr.

N69-14091 Maryland Univ., College Park.
A SIMPLIFIED APPROACH TO THE TREATMENT OF NEUTRON-PROTON CORRELATIONS
Jyoti Amritlal Shah (Ph.D. Thesis) 1967 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3382

Shell model calculations have been done for the cases where there are two protons and two nautrons outside the doubly closed shell. The calculations have been done in four different ways. (1) By using usual pairing centigurations and T=1 forces. (2) By introducing T=0 forces in the above scheme. (3) By adding quarteting centigurations to the scheme: 2. (4) By a more general method where the complete set of four-body wave functions is used with a restriction that like nucleons occupy the same j state. The results of the above four cases are compared in the last two chapters. Also, a general method of computing the two body matrix element—central as well as tensor—is given. Dissert. Abstr.

N69-14100# Los Alamos Scientific Lab., N. Mex.
NEUTRON CROSS SECTIONS FOR U^{235} AND U^{238} IN THE ENERGY RANGE 1 keV TO 14 MeV
J.-J. H. Berlijn, R. E. Hunter, and C. C. Cremer 5 Sep. 1968 33 p refs
(Contract W-7405-ENG-36)
(LA-3527) Avail: CFSTI

Recommended cross sections for ^{235}U and ^{238}U are presented. Comparisons of calculated and experimental values of integral systems were used as a guide in choosing the fits to microscopic cross-section data. Author (NSA)

N69-14146 Florida State Univ., Tallahassee.
THE EFFECT OF COLLISIONS ON THE GENERATION OF HARMONICS IN NITROGEN
William Sloan Varnum (Ph.D. Thesis) 1967 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-5930

The effect of collisions on the generation of harmonics in ionized molecular nitrogen subjected to an alternating electric field is examined theoretically. The thirteen moment approximation has been used for the electron distribution function. In the case of a homogeneous alternating electric field in a uniform plasma it is shown that no second harmonic is generated, but a third harmonic is produced. The magnitude of the third harmonic current density is calculated. The non-linearity which must be present in the kinetic equations in order to produce harmonics is assumed to arise from velocity dependent electron-molecule collision frequencies. Available elastic and inelastic electron-molecule collision cross sections have been included in the calculations. The theoretical calculation of the third harmonic power generated is compared with two related microwave discharge experiments. Dissert. Abstr.

N69-14170# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
COMPARISON OF DIFFERENT PROCEDURES FOR ITERATIVE FITTING OF BUBBLE CHAMBER EVENTS INVOLVING NEUTRAL PARTICLES
Paul Arthur Baker (M.S. Thesis) Aug. 1968 35 p refs
(Contract W-7405-ENG-82)
(IS-T-265) Avail: CFSTI

The new method has two versions. The two versions resulted from two different ways of doing the calculation of errors associated with variables computed in the iteration procedure. Version 2 did better than version 1 in attaining the desired goals. The undesirable feature of the old method of doing the kinematical analysis was that it obtained too many "fake fits." Version 1 reduced the number of "fake fits" by 87%. This reduction is helpful in easing the job of ion checking. However, due to the rigidity of error assignments, version 1 lost up to 32% of the real fits. This loss cannot be rationalized by the time savings associated with the computation in the iteration procedure and with the ionization check. Version 2 reduced the number of "fake fits" by 47% and at the same time retained at least 85% of the real fits. Author (NSA)

N69-14216# National Research Council of Canada, Ottawa (Ontario).
MEASUREMENT OF DEAD TIMES BY THE METHOD OF COINCIDENCES [MEDIDA DE TIEMPOS DE PARALISIS POR EL METODO DE COINCIDENCIAS]
C. E. Granados et al 1968 8 p Transl. into ENGLISH from Anales Real Soc. Espan. Fis. Quim. (Madrid), ser. A, v. 63, 1963 p 155–159
(NRC-TT-1337) Avail: CFSTI

The correction formula for a very particular case of coincidence counting with different non-extending dead times in the two detector channels is derived. This formula provides a simple and accurate general method for measuring non-extending dead times. Author (NEA)

N69-14218# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
THE TRANSVERSE AND LONGITUDINAL CROSS SECTIONS FOR ELECTROPRODUCTION OF PIONS NEAR THE Δ (1236)-ISOBAR
W. Bartel, G. Weber, V. Walther, W. Schmidt, H. Krehbiel et al Aug. 1968 14 p refs Supported in part by Volkswagen Found.
(DESY-68/42) Avail: CFSTI

The reaction $e + p \rightarrow e' + N^*$ was studied for four momentum transfers up to 2.34 $(GeV/c)^2$ in the region of the 1236 MeV isobar. An analysis of the data in terms of the corss sections σ_T and σ_L for the absorption of transverse and longitudinal photons is given for invariant masses of the final pion nucleon system W = 1.220 GeV and W = 1.350 GeV. Author (NSA)

N69-14227# Idaho Nuclear Corp., Idaho Falls.
INTRODUCTORY COMPUTER PROGRAMS FOR NEUTRON DIFFRACTION
J. K. Boyter and R. M. Brugger Aug. 1968 76 p refs
(Contract AT(10-1)-1230)
(IN-1214) Avail: CFSTI

A series (6) of procedures for processing data generated by the MTR Time-of-Flight Diffractometer are described. Five of these procedures--4 crystallographic and 1 for calculating constants for the diffractometer--are programmed in FORTRAN 63 for the CDC 1604 computer. The sixth procedure is a scheme for calculating the Debye-Waller Factor of a crystal. Author (NSA)

N69-14250*# Oak Ridge National Lab., Tenn.
DATA SUMMARIES (NUCLEAR-STRUCTURE PHYSICS) TABULAR AND GRAPHICAL SUMMARIES OF EXPERIMENTAL RESULTS REPORTED IN RECENT ISSUES OF SELECTED JOURNALS
S. Raman and J. Miller Sep. 1968 208 p refs
(Contract W-7405-eng-26)
(ORNL-4317-1) Avail: CFSTI

Graphical and tabular summaries of the results of experimental studies of nuclear structure are presented. The information was taken from issues of the journals Nuclear Physics, Physical Review, Physical Review Letters, and Physics Letters for the period Jan. through March 1968. The abstracts from the journal articles are reproduced, together with the data. NSA

N69-14255# Physikalisches Staatsinstitut, Hamburg (West Germany).
STUDY OF THE THREE POINT FUNCTION OF THE VECTOR AND AXIAL VECTOR CURRENTS BY MEANS OF CURRENT ALGEBRA AND THE METHOD USED [UNTERSUCHUNG DER DREIPUNKTFUNKTION DER VEKTOR UND AXIALVEKTORSTROEME MIT DEN MITTELN DER STROMALGEBRA UND VERWANDTEN METHODEN]
K. Fabricius Jul. 1968 50 p refs In GERMAN
(DESY-68/39) Avail: CFSTI

The ideas of current algebra, the stronger assumption that SU(2) × SU(2) symmetry becomes exact for infinite momentum, and assumptions concerning pole dominance are applied to the three-point functions of the vector and axial vector currents of the group SU(2) × SU(2) and systematically exploited. It is shown that the three point functions in this approximation are described completely by the constants g_ρ, F_π and m_ρ. The Kawarabayashi-Suzuki relation does not follow. Author (NSA)

N69-14280 Rensselaer Polytechnic Inst., Troy, N. Y.
LINEAR ACCELERATOR PROJECT Progress Report, Jan. 1-Mar. 31, 1968
31 Mar. 1968 84 p refs
(Contract AT(30-3)-328)
(RPI-328-123) Avail: CFSTI

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4. LOW ENERGY NEUTRON INELASTIC SCATTERING (LENIS) p 32-38 (See N69-14284 04-24)
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N69-14281 Rensselaer Polytechnic Inst., Troy, N. Y.
NEUTRON CROSS SECTIONS
In its Linear Accelerator Proj. 31 Mar. 1968 p 1-17 refs (See N69-14280 04-24)
Avail: CFSTI

The average capture cross sections of W, ^{182}W, ^{184}W, and ^{186}W in the energy range from 1 to 100 keV were determined. The *p*-wave strength functions for ^{56}Fe and ^{58}Ni were extracted from capture data, and the radiative width of the 4.6-keV resonance in ^{62}Ni was determined. The total cross section of ^{147}Pm was determined by transmission measurements on four $^{147}Pm_2O_3$ samples over the energy range from 0.008 to 200 eV; neutron resonance parameters were obtained for energies up to 120 eV. NSA

N69-14282 Rensselaer Polytechnic Inst., Troy, N. Y.
FAST REACTOR PHYSICS EXPERIMENTAL
In its Linear Accelerator Proj. 31 Mar. 1968 p 18-25 refs (See N69-14280 04-24)
Avail: CFSTI

The analysis of time-of-flight measurements of fast neutron spectra in depleted uranium was continued, and computer programs were developed for analyzing time-of-flight data on fast neutron spectra. Preliminary results of measurements of position-dependent fast neutron spectra in iron are also reported. NSA

N69-14283 Rensselaer Polytechnic Inst., Troy, N. Y.
NEUTRON THERMALIZATION EXPERIMENTAL
In its Linear Accelerator Proj. 31 Mar. 1968 p 26-31 refs (See N69-14280 04-24)
Avail: CFSTI

The phased chopper-linear accelerator technique was used with an on-line computer to measure time-dependent thermal neutron spectra in the center of a light water slab. NSA

N69-14284 Rensselaer Polytechnic Inst., Troy, N. Y.
LOW ENERGY NEUTRON INELASTIC SCATTERING (LENIS)
In its Linear Accelerator Proj. 31 Mar. 1968 p 32-38 (See N69-14280 04-24)
Avail: CFSTI

The General Multiple Scattering Program was successfully run using a GASKET scattering law for H_2O in a realistic situation. The incident energy considered was 0.499 eV, and the sample thickness was 0.028 in. Correction factors were calculated for six angles, corresponding to an experimental arrangement. An attempt to resolve previously reported discrepancies between experimental data and theoretical predictions for double differential scattering on hot water was initiated. NSA

N69-14288*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUANTUM THEORY OF A PARTICLE OSCILLATOR COLLISION APPLIED TO GAS-SURFACE INTERACTIONS AT CRYOGENIC TEMPERATURES

Jerry D. Smith Washington Dec. 1968 40 p refs
(NASA-TN-D-4982) Avail: CFSTI CSCL 20J

The Schroedinger equation was solved numerically for a one-dimensional collision between a harmonic oscillator and a particle, with a rectangular trapping potential. General solutions were sums of states, each a product of a particle wave function and an oscilator wave function. A correlation was suggested between probability current densities for states within the well and sticking of gas atoms on surfaces, where sticking is regarded as arising from multiple collisions. Energy accommodation coefficients were formulated and compared with helium–tungsten experiments for the temperature range 20° to 120°K. The theory underestimates the accommodation coefficient at lower temperatures and overestimates it at higher temperatures. Results indicate that only approximate qualitative predictions of the coefficient are possible with this simplified model. Author

N69-14294# Atomic Energy Establishment, Winfrith (England). Chemical Reactor Physics Div.
THERMAL NEUTRON CAPTURE CROSS SECTIONS OF COBALT
J. S. Story May 1968 13 p refs
(AEEW-R-597) Avail: CFSTI

Experimental data on the thermal neutron capture cross section of cobalt and the cross sections for activation of the 10.5-min and 5.26 yr isomeric states of ^{60}Co are summarized, and the following weighted mean values are derived: σ_{nA}=37.55±0.13 barns and σ_{act}=37.50±0.13 barns for activation of the 5.26-yr ground state of ^{60}Co both directly and by decay of the isomeric state. For activation of the 10.5-min isomeric state of ^{60}Co σ_{act}=19.9 ±0.91 barns. A summary is made also of the experimental data on the half-lives of the ^{60}Co isomers. Author (NSA)

N69-14305# Brown Univ., Providence, R. I. Dept. Physics.
SOFT PION SUMMATIONS AND A CHIRAL CANCELLATION
H. M. Fried Aug. 1968 20 p refs Presented at the Summer Inst. for Theoret. Phys., Boulder, Colo., Jun. 1968
(Contract AT(30-1)-2262)
(NYO-2262-TA-191) Avail: CFSTI

A method of summing a portion of the virtual soft pion dependence for hadronic processes, taking pion correlations partially into account, is applied to the nucleon electromagnetic form factors. No damping at large momentum transfer is found, but rather a tendency toward enhancement which is removed by a delicate cancellation generated by the chiral nature of the soft pion–nucleon interaction. Author (NSA)

N69-14311 California Univ., Berkeley.
TEST OF TIME REVERSAL INVARIANCE IN BETA DECAY OF NEON-19 AND BETA DECAY ASYMMETRIES
Gerald Lee Wick (Ph.D. Thesis) 1967 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-5847

Delayed coincidences of the positron and recoil F^- ion from decays in flight of an atomic beam of nuclear spin polarized neon-19 were recorded. From this information the time reversal coefficient, D, and the neutrino asymmetry coefficient, B, were determined. The positron asymmetry coefficient, A, was measured by capturing polarized neon-19 in a bulb and detecting counts parallel and anti-parallel to the spin. There was no noticeable relaxation of the spins in this measurement. Time reversal is usually discussed in terms of the phase angle, θ, between the complex vector and axial-vector coupling constants of beta decay. Time reversal invariance implies that this angle be θ=0° or 180°. The coefficient D is proportional to sin θ. The quadrant may be determined from A + B which is proportional to cos θ. This result is consistent with T invariance. It also adds confirmation to the V-A theory of weak interactions. Dissert. Abstr.

N69-14326# Brookhaven National Lab., Upton, N. Y.
FIELD MEASUREMENTS OF VARIABLE β MULTI-STEM ACCELERATING STRUCTURE
S. Giordano and J. Hanrwacker [1967] 10 p refs Presented at Conf. on Proton Linear Accelerators, Upton, N. Y.
(BNL-12794; CONF-680515-26) Avail: CFSTI

The axial electric field distributions of a single stem and a multistem drift tube support for a variable β cavity were measured and evaluated. It is seen that multistems can substantially reduce the electric field distortions introduced by both the change in β and those caused by detuning perturbations NSA

N69-14358 Yale Univ., New Haven, Conn.
DETERMINATION OF MUONIUM HYPERFINE INTERVAL THROUGH MEASUREMENTS AT LOW MAGNETIC FIELD
Patrick Andrew Thompson (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-6661

An important test of the validity of the application of quantum electrodynamics to the muon is a comparison of the theoretical hyperfine structure splitting ($\Delta \nu$) of the muonium atom (μ^+e^-) with an experimental measurement of this quantity. Previous experiments at fields of about five kilogauss have given agreement between the theoretical and experimental values. A measurement of this quantity at low (less than 10 gauss) fields involves different experimental techniques and thus provides a check of the high field measurement. Experimental measurements have been made of this quantity at fields of about 3 gauss and 13 milligauss, by observing microwave transitions between magnetic sublevels of the ground state of the muonium atom. The measured value $\Delta \nu$ = 4463.19 ± 0.06 Mc/sec is in good agreement with the previous measurement at high field. Assuming that the theory is well understood, a value of the fine structure constant α may be determined from these measurements. This value is α^{-1} = 137.0368 ± .0014. The measurements at 13 milligauss coupled with a theoretical calculation of the line shape at this field have established the usefulness of this magnitude for future experiments. This is of importance because the experimental signal is four times as large for milligauss fields as it is for fields of a few gauss. Dissert. Abstr.

N69-14369 California Univ., Berkeley.
SYMMETRY AND REGGE POLE THEORY
Jiunn-Ming Wang (Ph.D. Thesis) 1967 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-5842

For reactions in which the initial and final states in the t-channel contain equal mass particles (e.g., $N\bar{N} \rightarrow \pi\pi$) of masses m and m', it is shown by using analytic continuation and Lorentz invariance that the on-mass shell helicity amplitudes in the region $t = 0$, $(m - m')^2 \leq s \leq (m + m')^2$, are invariant under the group O(4). Decompositions of the amplitudes in irreducible representations of O(4) (four dimensional partial wave expansions) are obtained and related to conventional partial wave expansions. Poles classified according to the O(4) group are shown to lead to infinite families of Regge poles. The formalism is developed for arbitrary spins and the case of nucleon-nucleon scattering is studied in detail. Our results of the Regge pole structure in NN scattering are stronger than those of the conspirator theory. Dissert. Abstr.

N69-14390# Naval Research Lab., Washington, D. C.
AN EMPIRICAL APPROACH TO THERMAL NEUTRON ABSORPTION CROSS SECTIONS Final Report
S. Podgor Sep. 1963 10 p refs
(AD-677034; NRL-6783) Avail: CFSTI CSCL 20/8

A simple procedure is proposed to simulate the cyclic variation of the thermal neutron absorption cross sections of the odd-Z, even-N nuclei. The assumption is made that the cross sections vary with (a) the number of protons in the last open proton shell, and (b) the number of neutron holes in the last open neutron shell. With the major nuclear shells as a basis and with variations as to which subshells are included, empirical results are obtained and compared with the experimental cross-section curve. Preliminary indications are that the proposed method gives results that follow the trend of the experimental data. Author (TAB)

N69-14395# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

DYNAMICS OF BINARY COLLISION AMONG FOUR PARTICLES Interim Report

Mihir K. Ghosh (M.A. Thesis) Jul. 1968 79 p refs

(Grant AF-AFOSR-1015-A-67)

(AD-677583; BN-561; AFOSR-68-2355) Avail: CFSTI CSCL 7/4

Dynamical events consisting of five-successive binary collisions among four hard sphere molecules are studied by means of the binary collision expansion. The phase space diagrams of different events are sketched and the events studied. The divergence of these diagrams in two dimensions is computed by doing the phase space integration. Author (TAB)

N69-14398*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CHARACTERISTICS OF COMPOSITE CARBON RESISTORS USED FOR MEASURING ACCELERATOR TERMINAL VOLTAGES

Frank R. Stevenson and Daniel J. Gauntner Washington Jan. 1969 13 p refs

(NASA-TM-X-1718) Avail: CFSTI CSCL 09A

A voltage-divider board, composed of 1152 22-MΩ composite carbon resistors used to measure the terminal voltage of a 3-MeV Dynamitron, was investigated. The board was calibrated in place by using the Be^9 and D photoneutron threshold reactions and a magnetic analyzer. The present calibration of the divider board, made after more than 5 years of extensive accelerator usage agreed within 2 percent with the original factory calibration. The temperature and voltage coefficients of resistance were also measured. Results showed that composite carbon resistors and the techniques described can be applied with confidence to the measurement of high voltage. Author

N69-14413 Fordham Univ., New York.

A NUCLEAR MAGNETIC RESONANCE STUDY OF PALLADIUM AND IRON HYPERFINE INTERACTIONS IN FERROMAGNETIC PALLADIUM-IRON ALLOYS

John Lechaton (Ph.D. Thesis) 1967 142 p

Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-3698

The purpose of this dissertation was to study the details of long-range polarization using spin-echo techniques of nuclear magnetic resonance. The hyperfine interaction energy for both the ^{105}Pd and ^{57}Fe nuclei were measured and the palladium hyperfine field was related to the atomic moment of the palladium atom by an average coupling constant (340 kOe/μ_B) which was determined from the ratio of the average hyperfine field to the average magnetic moment on palladium. The palladium hyperfine field distribution was found to be very broad (≈30 MHz) and contained several well resolved maxima (separated by 7 to 11 MHz). The maxima in these broad palladium spectra shift to higher frequencies as the iron concentration is increased and the amplitudes at the high frequency maxima increase in amplitude relative to the low frequency maxima. Dissert. Abstr.

N69-14414 California Univ., Berkeley.

POSITIVE KAON NEUTRON CHARGE EXCHANGE AND THE RHO PRIME REGGE TRAJECTORY

Bertram Marcus Schwarzschild (Ph.D. Thesis) 1967 43 p

Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-5818

Finding that the Regge exchange of ρ and A_2 fails to describe our K^+n charge-exchange data at 2.3 GeV/c when a simultaneous fit is attempted with higher energy data on K^-p and π^-p charge exchange and $\pi^-p \rightarrow \eta^0 n$, we introduce a second, lower lying ρ-type trajectory (ρ'). This also provides a possible mechanism for the puzzling π^-p charge-exchange polarization. We find that we are then able simultaneously to fit all these data (including the polarization), together with related total cross-section differences up to 20 GeV/c, with a ρ' whose spin 1 mass is 1.0 GeV and whose $t = 0$ intercept, 1.1 units of angular momentum below the ρ, agrees roughly with the ρ' proposed by Högaasen and Fischer to describe forward $\bar{p}p$ and np charge exchange, where the (ρ, A_2) model also fails. Our ρ and A_2 trajectories turn out to be essentially traditional. Dissert. Abstr.

N69-14417# Los Alamos Scientific Lab., N. Mex.

NEUTRON CROSS SECTIONS FOR SUP 239 PU AND SUP 240 PU IN THE ENERGY RANGE 1 KEV TO 14 MEV

R. E. Hunter, J.-J. H. Berlijn, and C. C. Cremer 4 Sep. 1968 27 p refs

(Contract W-7405-ENG-36)

(LA-3528) Avail: CFSTI

Recommended cross sections for ^{239}Pu and ^{240}Pu are presented. Comparisons of calculated and experimental values of integral systems were used as a guide in choosing the fits to microscopic cross-section data. Author (NSA)

N69-14419 Michigan State Univ., East Lansing.

A VIBRATIONAL ANALYSIS OF SODIUM TETRAZOLATE: TETRAZOLE COMPLEXES OF NICKEL(II) AND COPPER(II)

Lawrence Lee Garber (Ph.D. Thesis) 1967 107 p

Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-4137

The vibrational analysis of sodium tetrazolate was made by means of a normal coordinate analysis calculation of the tetrazolate ion. The symmetry of the tetrazolate anion is C_{2v}. The calculated A_1 modes are 3124, 1461, 1243, 1138 and 962 cm^{-1}, and may be attributed to the C–H stretch, two symmetric ring deformations, a symmetric ring breathing, and a symmetric ring deformation, respectively. The calculated B_1 modes are 1453, 1063, 1013, and 730 cm^{-1}, and are attributed to the C–H bend and asymmetric ring deformations, respectively. The calculated B_2 modes and A_2 mode are 910 and 456 cm^{-1}, and 537 cm^{-1}, respectively and are attributed to the C–H out-of-plane wag, a ring out-of-plane bend which is asymmetric with respect to the C_2 axis and a ring out-of-plane bend which is symmetric with respect to the C_2 axis, respectively. Dissert. Abstr.

N69-14420 North Carolina State Univ., Raleigh.

AN INVESTIGATION OF ISOMERIC TRANSITIONS FOLLOWING THE DECAY OF Np 237, Am 241, AND Am 243

Edward Samuel Oberhofer (Ph.D. Thesis) 1968 82 p

Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-4384

Semiconductor detectors were employed in the study of the half-lives of certain transitions following the decay of ^{237}Np, ^{241}Am, and ^{243}Am and in the investigation of the gamma spectra from sources of these nuclides. Each of the levels whose half-life was measured is populated by an alpha-particle transition and depopulated by a gamma-ray transition. Silicon surface barrier detectors were used for alpha-particle detection and an NaI scintillator mounted on a photomultiplier was used for gamma-ray detection in the half-life measurements. A lithium-drifted germanium

detector was used for gamma-ray detection in the gamma spectra measurements. An IBM 360 Model 30 computer was used to fit the half-life data to a simple exponential function by the method of least squares. Dissert. Abstr.

N69-14440 Duke Univ., Durham, N. C.
NEUTRON HELIUM SCATTERING AT ENERGIES BELOW 8 MeV
George Lake Morgan (Ph.D. Thesis) 1967 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-5230

Precision relative differential cross sections for the scattering of neutrons from helium were measured at 22 neutron energies between 0.2 and 7.0 MeV. The measurements were made by observing the energy distribution of the recoiling helium nuclei in a high pressure helium gas scintillation counter irradiated by monoenergetic neutrons. The $Li^7(p,n)Be^7$, $C^{12}(d,n)N^{13}$, $T(p,n)He^3$, and $D(d,n)He^3$ reactions were used as neutron sources. Pulsed beam techniques were employed in conjunction with two dimensional pulse height analysis by an on-line computer in order to acquire detailed information on the correlation between time-of-flight and scintillation pulse height for the radiation incident on the counter. This procedure allowed discrimination against events in the counter produced by gamma rays and energy degraded neutrons. Dissert. Abstr.

N69-14442 Pittsburgh Univ., Pa.
QUANTUM MECHANICAL STUDY OF POTENTIAL ENERGY SURFACES OF SMALL MOLECULAR SYSTEMS
Rochelle Braunstein Abrams (Ph.D. Thesis) 1967 193 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-4426

Quantum mechanics is used to study the potential energy surfaces of certain small molecular systems. The Diatomics-in-Molecules approach is used to examine the electronic structure of H_4, H_5, and H_6 in a variety of spatial configurations and electronic states. In the DIM approach the molecular wave function Θ is expanded linearly in terms of a canonical set of valence wave functions, $\Theta = \Sigma a_n \Psi_n$. The energy matrix elements, $H_{nm} = \int \Psi_n H \Psi_m d\tau$, are expressed in an approximate but well-defined manner in terms of experimental (or independently evaluated theoretical) ground and excited state energies of all possible diatomic and monatomic fragments which comprise the polyatomic system as well as structure overlap integrals, $S_{nm} = \int \Psi_n \Psi_m d\tau$. In agreement with experiment and previous theoretical calculations, it is found that H_4, H_5, and H_6 are stable relative to the component H atoms separated at infinity but unstable relative to the component H_2 molecules. Dissert. Abstr.

N69-14443 New York Univ., N. Y.
NEUTRINO PAIR RADIATION BY RELATIVISTIC ELECTRON BREMSSTRAHLUNG
George G. Festa (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-6062

Starting with the assumption that there exists a direct coupling between the electron and the neutrino, a calculation is made of the neutrino pair flux produced when hot, degenerate, relativistic electrons undergo scattering with positively charged nuclei by a shielded Coulomb interaction. This process is called neutrino bremsstrahlung. Several models of white dwarfs and neutron stars are constructed to show that their electrons exist in a hot, degenerate, relativistic state. The neutrino pair flux calculation is then applied to white dwarfs and neutron stars and compared with other forms of energy radiation from these stars. The effect on the neutrino flux if the positive nuclei were to form a lattice instead of being randomly oriented is examined. Such a lattice state is shown theoretically to exist for some regimes of temperature and density in white dwarfs. Dissert. Abstr.

N69-14448*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORETICAL MOLECULAR LINE ABSORPTION OF CO IN LATE SPECTRAL TYPE ATMOSPHERES
Virgil G. Kunde Washington Dec. 1968 37 p refs
(NASA-TN-D-4798) Avail: CFSTI CSCL 07D

The line positions, line intensities, and collisional line half-widths were calculated for the fundamental, first-overtone, and second-overtone vibration-rotation bands of $C^{12}O^{16}$ and $C^{13}O^{16}$. The $C^{12}O^{16}$ and $C^{13}O^{16}$ line intensities were computed for temperatures ranging from 175° to 3500°K and were weighted in accordance with a terrestrial C^{12}/C^{13} abundance ratio. All lines within 5 to 6 orders of magnitude of the maximum line intensity of a band were considered (≈4500 lines at 36°K). Author

N69-14482*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCATTERING OF 42 MeV (6.7pJ) ALPHA PARTICLES FROM EVEN ISOTOPES OF CADMIUM. SUPPLEMENT 1: ABSOLUTE CROSS SECTIONS
Norton Baron, Regis F. Leonard, and William M. Stewart Washington Dec. 1968 14 p ref
(NASA-TN-D-4948) Avail: CFSTI CSCL 20H

Measurements were performed to permit the determination of absolute cross sections for elastic and inelastic scattering of 42 MeV alpha particles from the even isotopes of cadmium. Previously reported measurements could not be converted to absolute cross sections because of the presence on the targets of a gold backing of unknown thickness. The thickness of the backing has been determined by measuring the yield of elastically scattered alpha particles from a gold foil of known thickness and comparing this yield with that observed from the gold backing during the cadmium experiment. Optical model and distorted-wave Born approximation calculations are carried out and compared with the absolute cross sections. Author

N69-14498# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MOESSBAUER EFFECT
Y. Li 4 Dec. 1967 17 p refs Transl. into ENGLISH from Wu Li Tung Pao (Peking), no. 4, 1961 p 129-135
(AD-677213; FTD-HT-67-391) Avail: CFSTI CSCL 20/B

The article briefly introduces the Mossbauer effect and its application. This effect, which is also called recoilless nuclear resonance recoilless nuclear resonant fluorescence, was discovered by a German scientist, R. L. Mossbauer in 1957. Since its discovery this effect has become an important tool in basic physics research. Its principle applications are in the following areas: (1) theory of relativity; (2) nuclear structure; (3) solid state physics and (4) nuclear timer. The article also briefly describes the principle of Mossbauer effect, its application in the above four areas and problems related to the experimental research. TAB

N69-14502 Washington Univ., St. Louis, Mo.
SEARCH FOR PARITY NONCONSERVATION IN Fe-57 BY STATIC MOSSBAUER ABSORPTION
Donald Alton Emmons (Ph.D. Thesis) 1967 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-5130

This thesis reports on an effort to extend the result of Grodzins and Genovese, who first looked for parity mixing in the 14.4 kev transition of Fe^{57} using the Mössebauer effect. Recently Kankeleit has also performed a Mössebauer absorption velocity scanning experiment and reported a polarization of $(2 \pm 6) \times 10^{-6}$. Resonance absorption of low energy nuclear radiation (Mössebauer effect) allows the direct observation of hyperfine components resolved by the large effective magnetic field at the iron nucleus. For longitudinally magnetized iron these components are circularly

polarized, and if equal substate populations exist then unequal intensities would indicate a net circular polarization arising from parity nonconservation. In the present experiment two of the hyperfine lines of one polarization sense from Fe^{57m} in magnetized iron are resonantly absorbed in a static geometry by two lines of Fe^{57} in Fe_2O_3. Dissert. Abstr.

N69-14511 Texas Univ., Austin.
EXPERIMENTAL INVESTIGATION OF CLUSTER STATES IN O 15
Prakash Narayan Shrivastava (Ph.D. Thesis) 1966 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-4368

^{14}N was bombarded with protons of energy between 6 and 11.5 Mev and the angular distributions and the integrated cross-sections were measured for the emergent charged particle groups. The cross sections for elastic and inelastic scattering of neutrons between 13 and 21 Mev from ^{12}C have been measured. A proton recoil telescope for neutrons has been constructed. The ratio of L to K fluorescent yields in ^{198}Hg was measured by using a thin (1 mm) NaI scintillator. The (p,p') and (p,n) cross sections for ^{63}Cu and ^{65}Cu have been measured in the proton energy range of 6 to 12 Mev. In a magnetic field that varies as $1/r$ electrons and positrons can be made to go in opposite directions in trochoidal paths. The focussing property of such paths makes it possible to obtain a high transmission spectrometer for electron-positron pairs. Dissert. Abstr.

N69-14551 North Carolina State Coll., Raleigh.
THEORETICAL INVESTIGATION OF SOME MASS TRANSFER PROBLEMS WITH RADIOACTIVE DECAY AND WALL REACTION
Paul Chun-Yung Chen (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-4383

Transport of radioactive molecules and of steam vapor through an isothermal and noncondensable gas in a containment vessel is theoretically investigated. The mass transfer problems include radioactive molecules deposited on the wall surface as a function of time, with and without steam vapor condensation, for perfect sink, imperfect sink, and changeable wall surface conditions. In formulating the boundary value problem of mass transfer, it is assumed that the molecules diffuse through the uniformly distributed gas mixture to the immediate vicinity of the wall surface where they strike and adhere to the wall. For the radioactive molecules deposited on the wall surface of a containment vessel with any shape, two generalized, three-dimensional coupled equations, one for the concentration of radioactive molecules in the gas mixture and the other for conservation of molecules in the gas mixture and on the wall surface, are transformed into one integral equation. Dissert. Abstr.

N69-14561# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
POSSIBILITY OF ABNORMALLY LARGE WIDTH OF E(1420)→2γ DECAY
A. N. Zaslavskii and B. Tybor 1968 11 p refs In RUSSIAN
(JINR-P2-4035) Avail: CFSTI

Evaluations were made of the width of the decay E→2γ within the limits of disturbed symmetry $SU(6)_W$. The magnitude of the width strongly depends on the scheme of disturbance of $SU(6)_W$. An abnormally large width of ~1 MeV was found to be quite feasible. Author (NSA)

N69-14575 South Carolina Univ., Columbia.
VIBRATIONAL ANALYSIS AND STRUCTURE OF SOME SMALL NITROGEN CONTAINING MOLECULES
Stewart Fowler Bush (Ph.D. Thesis) 1967 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-3925

The mid infrared spectra of liquid, solid and gaseous tetradeuterated hydrazine have been measured from 250 to 4000 cm^{-1}. Fine structure was resolved for three of the perpendicular fundamental bands of the nearly symmetric top and the parameter for the equilibrium angle of internal rotation was determined to be approximately 90°. The Raman spectra of liquid hydrazine and tetradeuterated hydrazine have been recorded and depolarization values measured. A complete vibrational analysis based on band type, position, and depolarization values is given which satisfies the product rule for both the a and b vibrational symmetry species. The intensity of the 3189 cm^{-1} band of hydrazine has been studied as a function of temperature. $\Delta H°$ for H-bond formation in hydrazine is found to be −1450 cal/mole. The relative intensity of the 3189 cm^{-1} band to that of the 3260 cm^{-1} band has been studied as a function of concentration in dimethylsulfoxide and indicates that part of the intensity of 3189 cm^{-1} band arises from a vibrational mode of the hydrazine monomer. Dissert. Abstr.

N69-14581# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ELASTIC SCATTERING (POSITIVE PION PROTON) AT 2.34 GeV/c POSITIVE PION MESON MOMENTUM
N. Angelov, I. M. Gramenitskii, Kh. Kanaziraki, A. M. Moiseev, L. A. Tikhonova et al 1968 13 p refs In RUSSIAN
(JINR-P1-4003) Avail: CFSTI

Data are given on elastic π^+p-scattering at 2.34 GeV/c momentum. Total cross sections and the differential cross section dip at small momentum transfer were determined using 5500 events of $\pi^+p \rightarrow \pi^+p$ interactions. Comparisons were made of the published data for π^+ mesons with identical momentum magnitudes. Author (NSA)

N69-14582# Joint Inst. of Nuclear Research, Dubna (USSR). Lab. of High Energy.
FORMATION OF (e+e−) PAIRS BY ELECTRONS WITH 1.25 TO 4 GeV ENERGIES
Ya. Bem, V. G. Grishin, M. M. Muminov, and V. N. Strel'tsov 1968 19 p refs In RUSSIAN
(JINR-P1-4023) Avail: CFSTI

A propane bubble chamber was used for measuring the cross section of (e+e−) pair production by electrons at 1.25 to 4 GeV. Obtained experimental and theoretical data are in good agreement. A special method was developed for measuring small distances in the bubble chamber. Author (NSA)

N69-14589 Maryland Univ., College Park.
A STUDY OF FINAL STATES WITH A $K\bar{K}$ PAIR PRODUCED BY 4.25 BeV/c K^- IN HYDROGEN
Gerald Stanely Abrams (Ph.D. Thesis) 1967 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-7003

Final states in which both K and $\bar{K}$ mesons are produced in hydrogen have been analyzed at a K^- beam meomentum of 4.25 BeV/c. A main concern of this experiment was a study of strangeness −2 baryon states. Weak evidence is presented for the detection of the ξ^* (1815) found at lower energies. The data offer no other evidence of ξ^* resonance production. The ϕ meson has been found to be produced relatively copiously, both in the $\Lambda\,\phi$ and in the $\Sigma\,\phi\,\pi$ states. Evidence has been found supporting the existence of the f°(1500). Evidence for a $K^0_1K^0_2$ enhancement near 1600 MeV has been found; the data do not demand a resonance interpretation. The most significant results of this experiment are the lack of any outstanding structure, and the small values of the observed cross sections. Dissert. Abstr.

N69-14593 Indiana Univ., Bloomington.
INDUCED VIBRATION-TRANSLATIONAL SPECTRA OF HYDROGEN, DEUTERIUM IN SOLID AND LIQUID ARGON
Hao-lin Chen (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-7209

The induced vibrational spectra of H_2 and D_2 in solid and liquid argon were studied. The solid spectrum consists of three sets of bands falling in the regions corresponding to vibration-rotation transitions. Each of these three sets exhibits the same frequency structure with a central line flanked by two pairs of bands at ± 23 cm^{-1} and ± 115 cm^{-1}. The liquid spectra are more intense than the solid spectra because of asymmetrical cavities in liquids. Broad vibration-translation absorption features in the liquid spectra which shift in frequency with temperature can be explained by a modified cell model which includes the effect of a cavity size distribution. The vibrational frequency shift of H_2 in the condensed phase is discussed in terms of solute-solvent interactions. The calculated solvent-shifts are in good agreement with the experiments. Dissert. Abstr.

N69-14595# Los Alamos Scientific Lab., N. Mex.
HAMILTON'S PRINCIPLE AND NUMERICAL SOLUTION OF THE VLASOV EQUATIONS
H. Ralph Lewis 13 Sep. 1968 15 p refs
(Contract W-7405-ENG-36)
(LA-3803) Avail: CFSTI

It is demonstrated how Hamilton's principle can be used to derive equations that approximate the Vlasov integro-partial differential equations. The Lagrangian that is used is sufficiently general to describe physical systems in which there are present any of a large class of material media that exhibit nonlinear polarizability and magnetizability. The aim is to obtain useful approximate equations that are more convenient for numerical solution than the exact integro-partial differential equations. The approximate equations that are emphasized are a system of ordinary differential equations in time, although the basic method can be used to derive other approximate equations, such as a system of difference equations. The basic method can be applied to any Lagrangian system. The equations for a simple, one-dimensional example are displayed explicitly. Author (NSA)

N69-14616 Tennessee Univ., Knoxville.
AN INVESTIGATION OF THE EFFECT OF BEAM CONVERGENCE AND PARTIALLY COHERENT MULTIPLE SCATTERING ON LINE SHAPE
Harlan Goldring (Ph.D. Thesis) 1967 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3742

The purpose of this investigation was to determine whether the experimentally observed deviations of pressure-broadened hydrogen fluoride absorption lines from the theoretical Lorentz shape could be explained by taking into account the multiple absorption and emission of resonance line photons. The Monte Carlo method was used to trace the life histories of photons as they transversed the absorption cell, using the same geometry as in the actual experimental measurements. Photons were characterized according to how they escaped the absorption cell, their escape energy or frequency, and their direction of motion upon escaping. The absorption line shape was numerically calculated by considering only those photons which escaped the absorption cell through its exit end in such a way as to be focused upon the detector. An IBM 7040 digital computer was used to make these calculations. Dissert. Abstr.

N69-14624# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON A MODEL OF INHOMOGENEOUS MAGNETIZATION IN THE THEORY OF SPIN-WAVE RESONANCE IN A THIN FERROMAGENTIC FILM
V. M. Sokolov and B. A. Tavger [1968] 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz. (Gorkii), v. 9, no. 2, 1966 p 308-313
Avail: Issuing Activity

The degree of inhomogeneous magnetization of a thin ferromagnetic film is found as a function of the boundary conditions. To solve the problem of spin wave resonance, two customary limiting cases were selected: a fixed boundary, and a free boundary. It is assumed that the inhomogeneous magnetization is due to spin wave excitation and that it exists even in an ideal film. This circumstance is connected with the fact that a spin wave in a film, in contrast to a bulk sample, will be a standing wave across the film; therefore, magnetization of the film depends on z, with this dependence determined by the boundary conditions. Therefore, assigning the boundary conditions results in a definite kind of inhomogeneous magnetization and this natural inhomogeneity should be considered in solving the problem of spin wave resonance. Author

N69-14629 New York Univ., N. Y.
SOME ASPECTS OF TWO DIMENSIONAL QUANTUM FIELD THEORY
Daniel Abrom Dubin (Ph.D. Thesis) 1967 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-6057

The Lorentz and Poincaré groups are discussed as a background for quantum field theory in two dimensional space-time. A scalar formulation for the spinor and vector free fields is examined. The free massless scalar field is defined with the help of Wightman's regularization at $p = 0$. The one-particle sector is studied in detail and, when completed, is a Pontriagin space. An exactly solvable model of massless spinors interacting with massive vector mesons in two dimensions is investigated. Operator solutions are constructed out of free fields and depending upon which of two definitions of the current are employed. The freedom of gauge is considered and solutions in some different gauges are indicated. Finally, the limits $m_0 \to \infty$ to the Thirring model, and $m_0 \to 0$ to the Schwinger model are discussed. Dissert. Abstr.

N69-14631 Syracuse Univ., N. Y.
CONCENTRATION DEPENDENT RELAXATION STUDIES IN PHOSPHORUS-DOPED SILICON IN THE TEMPERATURE RANGE 2°K to .3°K
John Robert Marko (Ph.D. Thesis) 1967 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-5478

K-band relaxation measurements were made on two phosphorus-doped silicon samples in the region 1.8°K to 0.3°K by the use of a Helium-3 cryostat. The exponential portion of the relaxation was compared with the concentration dependent mechanism of Yang and Honig which involved spin diffusion from fast relaxing close donor pairs. The characteristics of these fast centers and the range of applicability of the theory are determined. Suggestions are made to account for deviations from the theory. Hole-burning experiments are carried out at X-band and K-band frequencies in the Helium-4 temperature region for samples of different concentrations. The results are correlated with earlier experiments of a similar type and are used to test the validity of the concentration dependent relaxation mechanism. Dissert. Abstr.

N69-14633# Argonne National Lab., Ill. Reactor Physics Div.
ANALYSIS AND REDUCTION OF PROTON-RECOIL DATA
E. F. Bennett, R. Gold, and I. K. Olson Jan. 1968 130 p refs
(Contract W-31-109-ENG-38)
(ANL-7394) Avail: CFSTI

A process for reducing 4π proton-recoil proportional-counter pulse-height distributions to fast-neutron energy spectra is described. Required corrections, including those associated with finite detector

size, are analyzed in detail. This procedure provides corrected neutron spectra in the region from about 1 keV up to several MeV. The computer programs used in this treatment (WERM, ITERATE, and PSNS) are discussed, and a sample problem illustrates and explains the manner in which these codes function. Author (NSA)

N69-14638# United Kingdom Atomic Energy Authority, Harwell (England).
THE PRODUCTION OF Pu 236 AND Np IN THE HARWELL VARIABLE ENERGY CYCLOTRON
I. L. Jenkins and A. G. Wain Jul. 1968 5 p
(AERE-R-5790) Avail: CFSTI

The production of ^{236}Pu and ^{235}Np in the Harwell Variable Energy Cyclotron is described. Yields of approximately 60 μCi of ^{236}Pu and 72 μCi of ^{235}Np were obtained by irradiating natural uranium with 50-MeV protons. Processing the target by dissolution in nitric acid, followed by precipitation, ion exchange, and amine extraction gave products of good radioactive purity. Author (NSA)

N69-14639# Washington Univ., St. Louis, Mo.
REACTION STUDIES OF HOT SILICON RADICALS Progress Report
Peter Paul Gaspar 30 Aug. 1968 4 p refs
(Contract AT(11-1)-1713)
(COO-1713-5) Avail: CFSTI

Reactions of silicon atoms recoiling from the nuclear transformation $^{31}P(n, p)^{31}Si$ with phosphine in mixtures with butadiene, silane, and ethylene are presented. Measurements of the absolute yields of two volatile radioactive products from phosphine–silane mixtures indicate that the product yields increase linearly with the concentration of nonradioactive silane. Ethylene was found to compete with silane for a common reactive intermediate. The reactions of recoiling silicon atoms with phosphine–butadiene mixtures have been found to produce several products which appear to contain a PH_2-group. The product spectrum from the reactor-neutron irradiation of silane differed from that obtained from the fast-neutron irradiation of phosphine–silane mixtures. Experiments have also been carried out on the chemistry of recoiling Ge atoms. NSA

N69-14642# Michigan Univ., Ann Arbor. Dept. of Physics.
MUON POLARIZATION IN NEUTRAL-KAON(3) DECAY
Michael J. Longo, Kenneth K. Young, and Jerome A. Helland Sep. 1968 69 p refs
(Contract Nonr-1224(23))
(AD-677064; REPT-03106-33-T; TR-33) Avail: CFSTI CSCL 20/8

An experiment to measure the polarization of muons from neutral-K(mu3) decay was carried out at the Bevatron with counter techniques. All three components of the polarization were measured. The time-reversal violating component transverse to the decay plane was found to be = - .005 plus or minus .019, which is consistent with T-invariance. The result for the form factor ratio zeta = f-/f+ was Re zeta = - 1.81 +0.50 or -0.26, Im zeta = - 0.02 plus or minus .08, Arg (zeta)-pi = 0.6 plus or minus 2.6 deg., if zeta is assumed to be independent of q sq. If zeta is not too strongly dependent on q sq., this result still holds true for zeta at q sq approx. = 2.65 (m sub pi) sq, the average q sq selected by our apparatus. Author (TAB)

N69-14650# Tokyo Univ. of Education (Japan). Physics Dept.
A THEORY OF MASSLESS FIELDS WITH ARBITRARY SPIN
Minoru Omote and Yoshimasa Takaya Oct. 1968 29 p refs
(TUEP-68-24) Avail: CFSTI

It is shown that fields to describe particles with vanishing mass and arbitrary spin S must satisfy a relativistically invariant, first order differential equation, which is a generalization of the Maxwell equation. Only when fields satisfy these differential equations can they be expanded in terms of bases of unitary representations of the inhomogeneous Lorentz group and define a Lorentz invariant inner product. It is further proved that such fields have only two helicity state ±S. Quantization of these fields and quantized physical operators are given. Author

N69-14657 Pittsburgh Univ., Pa.
SIMULTANEOUS PARALLEL PUMPING OF NUCLEAR AND ELECTRONIC SPIN WAVES
Freddie Ninio (Ph.D. Thesis) 1967 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-4441

In a magnetic medium in which the nuclei carry a magnetic moment, there exists a spectrum of nuclear spin waves in addition to the usual electronic spin waves, provided the temperature is sufficiently low. The possibility is investigated of joint excitation of nuclear and electronic magnons by parallel pumping; this process is analogous to "exchange pumping" of acoustic and exchange magnons in a ferrimagnet. First a simple ferromagnet is considered, then the ferrimagnet manganese ferrite, and finally the cubic antiferromagnet $RbMnF_3$. It is suggested that the process should be feasible, and that it should be possible thereby to excite nuclear spin waves of arbitrary k. The threshold pump field in a typical material is estimated to be of order 36 oe in magnitude, but it can be smaller in carefully prepared samples. Dissert. Abstr.

N69-14659 California Univ., Riverside.
STATISTICAL THERMODYNAMICS OF LIQUID POLYPHENYL CHAIN MOLECULES AND THEIR MIXTURES
Ronald Keith Clark (Ph.D. Thesis) 1966 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-4921

The pressure volume temperature properties of liquid benzene and 1,3,5-triphenylbenzene were measured. Temperature ranges were 15° to 285°C for benzene and 200° to 400°C for 1,3,5-triphenylbenzene with pressures up to 170 atm. Volumes were determined at each temperature and pressure point by measuring the difference in the amount of mercury needed to fill the system with and without the sample present. The volume data was fit to an equation containing terms up to quartic in temperature and quadratic in pressure and to the Tait equation. Data on biphenyl, m-, o-, and p-terphenyl were also fit to these two equations. The data on the polyphenyls were then treated by the statistical thermodynamic corresponding states models to investigate effects of intermolecular potential energy between segments and structural differences for the various polyphenyl molecules. Dissert. Abstr.

N69-14703# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi I Eksperimental'noi Fiziki.
AN ANALYSIS OF SOME DISCREPANCIES IN MASS-SPECTROSCOPIC DATA OBTAINED DURING THE PERIOD 1954–1958 [ANALIZ NEKOTORYKH RASKHOZHDENII V MASS-SPEKTROSKOPICHESKIKH DANNYKH, POLUCHENNYKH ZA PERIOD S 1954 PO 1958 g-g.]
G. Arutyunyants 1967 24 p refs In RUSSIAN
(ITEF-535) Avail: CFSTI

Discrepancies are considered for precise measurements of light atomic masses (up to ^{40}Ar) by the mass doublet method performed by Brookhaven and Minnesota University groups during the period 1954 to 1958. Systematical variation in the doublet values vs time of their observation is noted. These discrepancies are difficult to explain because of the systematic changes in the apparatus. A new explanation of this effect is proposed, assuming that the variations of atomic masses are real and are about some parts in 10^{-7} to 10^{-6} of the mass number per year. Based

on the liquid-drop model, formulas were obtained to describe these variations. The agreement of the experimental and calculated data are satisfactory. Author (NSA)

N69-14706 Syracuse Univ., N. Y.
RADIATIVE ELECTRON TRANSFER FROM SHALLOW DONORS TO SHALLOW ACCEPTORS IN SILICON
Rudolph Carl Enck (Ph.D. Thesis) 1967 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-5456

The main objectives of this work were to determine the forbidden energy gap of silicon independently of theories of the exiton, to determine phonon selection rules for direct transitions from shallow donors to shallow acceptors in silicon, and to investigate the ionization energies of these shallow impurities. Measurements were made of recombination radiation as a function of time after the impurities were optically neutralized and a fit was made to a theory for direct donor to acceptor recombination. The forbidden gap was found to be 1.1675 ± .0010 eV, no-phonon as well as TA, TO and LA phonon assisted lines were observed, and the optically measured impurity ionization energies were found to be the appropriate ones leading to a consistent band gap. Dissert. Abstr.

N69-14707 Stanford Univ., Calif.
AN ANALYSIS OF SCATTERING IN THE QUARK MODEL
Maurice Victor Barnhill, III (Ph.D. Thesis) 1967 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-6385

Two calculations in the quark model are given. In the first, the linear parametrization of the hadron-hadron total scattering cross sections at high energy given by the additive quark model of Levin and Frankfurt and of Lipkin and Scheck is compared with experiment by a least-squares analysis using several different kinematic assumptions. The results indicate that improvement of the parametrization is desirable. Expressions for the corrections to the scattering cross sections due to shadowing and double-scattering processes are therefore obtained. In the second calculation, a model due to Schiff which accounts for the binding of quarks in terms of large, many-body potentials is extended to allow a semiqualitative discussion of scattering. It is found that, keeping only one-, two-, and three-body forces, the range of the repulsive three-body force must be larger than that of the attractive two-body force. Dissert. Abstr.

N69-14735 Texas Univ., Austin.
DWBA CALCULATIONS OF POLARIZATION AND ANGULAR DISTRIBUTION IN STRIPPING REACTIONS
Mohammad-Ali Alizadeh Toosi (Ph.D. Thesis) 1967 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-4348

Deuteron stripping polarizations and cross section angular distributions have been calculated using the distorted wave Born approximation for 11 (d,p) and two (d,n) stripping reactions for target nuclei in the range $9 \leq A \leq 88$, and for bombarding energies between 5 Mev and 15 Mev. Potentials include spin-orbit terms, and consist of an admixture of Saxon-Woods and surface-peaked interactions. Effects of varying the well and admixture parameters have been examined. The effect of finite range has also been considered. Comparison has been made with the available experimental data, and fairly good agreement has been obtained in certain cases. It has been found that the real part of the central potential appears to be mostly a volume-type interaction, though in some cases and admixture of volume and surface interactions may give somewhat better results for polarization. Dissert. Abstr.

N69-14746 Virginia Univ., Charlottesville.
MULTIPLY CHARGED IONS PRODUCED FOLLOWING THE X-RAY IONIZATION OF XENON
John Temple Bayliss (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-3105

A Paul-type mass spectrometer has been used to measure the relative abundances of multiply charged ions produced following the ionization of xenon by X-rays. V and Ti X-ray tube targets were used with a Ti X-ray filter and Cr and V targets were used with a V filter in order to distinguish the distribution of multiply charged ions resulting from initial vacancies in the L_3 subshell from that resulting from initial vacancies in the L_2 subshell. The average charge of the ions resulting from initial L_2 vacancies was found to be 9.15±.18. For initial L_3 vacancies the average charge was 8.65±.09. Dissert. Abstr.

N69-14747# Physikalisches Staatsinstitut, Hamburg (West Germany).
THE INFLUENCE OF THE (33) RESONANCE ON THE DISINTEGRATION OF THE DEUTERONS [DER EINFLUSS DER (33)-RESONANZ AUF DIE PHOTOSPALTUNG DES DEUTERONS]
Dieter Hasselmann Jul. 1968 46 p refs In GERMAN; ENGLISH summary
(DESY-68/38) Avail: Issuing Activity

The influence of the N^*-(33)-resonance on photodisintegration of the deuteron at 300 MeV is studied. The covariant model presented gives satisfactory agreement with experiment, especially for the total cross section, but the main qualitative features of the differential cross sections are also reproduced. It is found that, while the main contribution arises from the NN^* intermediate state, the Born terms may not be neglected, interference being quite important. The results depend strongly on the deuteron vertex function at high momentum transfers. NSA

N69-14749# Argonne National Lab., Ill.
DETERMINATION OF THE DIRECTION OF THE NEUTRAL HIGH-ENERGY PARTICLE BEAM OF THE JINR SYNCHROPHASOTRON BY CONVERSION PAIRS AND THE GAMMA-QUANTA SPECTRUM IN THIS BEAM
T. Beslin, V. Vishnevskii, M. Gavrilas, A. Constantinescu, A. Mihul et al [1968] 6 p refs Transl. into ENGLISH of the Russian rept. JINR-P-2916
(ANL-TRANS-640) Avail: CFSTI

The direction of the JINR synchrophasotron neutral particle beam in the bubble chamber was determined by conversion pairs. The accuracy of the beam axis is determined to be about $0.8 \cdot 10^{-3}$ rad. Author (NSA)

N69-14751# Brookhaven National Lab., Upton, N. Y.
NUMERICAL CALCULATIONS OF THE EFFECTS OF SPACE CHARGE ON SIX DIMENSIONAL BEAM DYNAMICS IN PROTON LINEAR ACCELERATORS
R. Chasman [1968] 20 p refs Presented at the Conf. on Proton Linear Accelerators, Upton, N. Y.
(BNL-12793; CONF-680515-27) Avail: CFSTI

Six dimensional linac orbit calculations, performed with a computer program which was designed to include space charge forces in a perfect linac, give a simple reliable prescription to match the beam to both the longitudinal and transverse admittances of the linac. The resultant beam envelope oscillations remain quite small during the acceleration. Matched beams with currents up to several hundred milliamperes can be accelerated through the linac using measured characteristics of recently developed preinjectors and high initial quadrupole gradients. There is considerable transverse emittance growth in beams with a brightness of 10^9 and higher. This appears to be caused by non-linear space charge forces. Author (NSA)

N69-14808*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE MAXIMUM NUMBER OF BINARY COLLISIONS FOR THREE RELATIVISTIC POINT PARTICLES
G. Doolen (NAS-NRC) May 1968 14 p refs
(NASA-TM-X-63423; X-641-68-205) Avail: CFSTI CSCL 20H

As a step toward understanding relativistic rescattering singularities we examine n_{max}, the maximum number of binary collisions allowed by special relativity among three particles with zero-range forces. We find that for three equal-mass particles $n_{max} = 3$ but for three particles with masses $m_1 = m_3 = 1$ and $m_2 = m < 1$, n_{max} decreases with increasing total energy, W, and finally attains the value of four when $W > 1/m$. Author

N69-14809# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
MICROWAVE SPECTRAL TABLES. VOLUME 5: SPECTRAL LINE LISTING
Marian S. Cord, Matthew S. Lojko, and Jean D. Petersen Jun. 1968 541 p
(NBS-MONOGRAPH-70-Vol-5) Avail: Issuing Activity

A comprehensive compilation of microwave spectral lines, previously reported, is presented according to ascending magnitude of frequency. For each spectral line the following data are given in order: the formula for the molecular isotopic species; the number of the volume of this series in which the line was originally tabulated (1, 3, or 4); the identification number used in that volume for ready reference; rotational quantum number, given in the general form $J', K'_{-1}, K'_{+1} \leftarrow J, K_{-1}, K_{+1}$ (primes denoting upper state); the vibrational state (ground, excited, or blank, if unknown); the hyperfine quantum numbers; the frequency, and its accuracy. Author

N69-14848*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A THEORY OF GAS-SURFACE INTERACTIONS AT SATELLITE VELOCITIES
D. P. Jackson Nov. 1968 172 p refs
(Grant NsG-367)
(NASA-CR-98699; UTIAS-134) Avail: CFSTI CSCL 07B

A classical three-dimensional model of the interaction of rare gas atoms with clean metal surfaces at satellite velocities is presented. The surface is assumed to be an ideal crystal plane with no thermal motion. The surface atoms are decoupled in collision and resume their original positions after a collision. The surface field is modeled by repulsive hard sphere collisions at an appropriate radius of interaction and a smooth normal attractive field due to the entire semi-infinite solid. A series of numerical experiments were performed and trapping, accommodation and flux and velocity distributions were found for a wide variety of situations. It is shown that even for the simple assumptions of the model the interaction is very complex. In particular recognizing the difference between semi-trapped and absolutely trapped particles is essential for accurate calculation of trapping and accommodation. Structure was found in some of the distributions and was explained by the differences in the behaviour of trajectories of singly and multiply colliding particles. The absolute flux levels obtained, when reasonable values of the two disposable parameters were used, compared well with an intermediate energy scattering experiment. Author

N69-14871# Los Alamos Scientific Lab., N. Mex.
GENERAL PURPOSE COMPUTER CODE FOR PARTICLE TRAJECTORIES AND OTHER PROBLEMS
H. R. Lewis, Jr. 16 Sep. 1968 20 p
(Contract W-7405-ENG-36)
(LA-3903) Avail: CFSTI

Instructions for using a computer code for computing and graphing the solutions of a general system of not more than six first-order differential equations are presented with an example. The user is allowed very flexible control of the type and format of graphical output by means of data cards. A listing of the code is given in FORTRAN for the CDC 6600. Author (NSA)

N69-14875 Utah Univ., Salt Lake City.
MUON INTENSITIES DEEP UNDERGROUND
Michael Oberlin Larson (Ph.D. Thesis) 1968 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-5116

Muon intensities at depths greater than 1700 hg/cm^2 have been studied using the Univeristy of Utah neutrino detector at Park City, Utah. The overburden provides a continuous range of depths from 1700 hg/cm^2 to 8000 hg/cm^2 in the zenith angle range of 40 deg to 80 deg. The trajectories of 14,543 muons were analyzed with an accuracy of ±0.5 deg in azimuth angle and ±1.0 deg in zenith angle. A concurrent experiment indicated that there was no significant zenith angle dependence to the muon spectrum for energies greater than 5×10^{11}eV. Thus a muon depth-intensity plot could be constructed using all muons independent of the zenith angle at which they entered the detector. Such a plot is presented using the 14,543 muons divided as to the amount of rock they traversed in reaching the apparatus. A comparison with previous depth-intensity measurements is made and good agreement found, particularly in the region around 2000 hg/cm^2 where previous workers have amassed considerable data. The present work increases by an order of magnitude the data on the vertical muon depth-intensity curve about 2000 hg/cm^2. Dissert. Abstr.

N69-14914# Stanford Univ., Calif. Stanford Linear Accelerator Center.
FOUR PI MASS ENHANCEMENTS IN 16 GeV/c NEGATIVE PION PROTON INTERACTIONS
J. Ballam, A. D. Brody, G. B. Chadwick, Z. G. T. Guiragossian, W. B. Johnson et al Aug. 1968 12 p refs Submitted for publication
(SLAC-PUB-480) Avail: CFSTI

In a 16 GeV/c π^-p experiment production of two 4π resonances at 1250 and 1700 MeV were observed whose predominant decay modes are $\omega^0\pi^-$ and ρ^0p^- respectively. Author (NSA)

N69-14952# Laboratoire de Physique Theorique et des Hautes Energies, Nice (France). Faculte des Sciences.
GROUP-THEORETICAL FOUNDATIONS OF CLASSICAL MECHANICS: THE LAGRANGIAN GAUGE PROBLEM
Jean-Marc Levy-Leblond Sep. 1968 18 p refs
(N-TH-68/6) Avail: CFSTI

The invariance principle is applied to study the Lagrangian gauge problem. The notion of group exponents and superequivalence and gauge functions are redefined, propositions stated and proved, and properties discussed. The lemmas are then applied to several examples in relativistic and nonrelativistic classical mechanics. The general group theory developed is then fitted to four one dimensional kinematical groups: Poincare, Galilei, Newton, and de Sitter. B.P.

N69-14991# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Servizio Documentazione.
DYNAMICAL NUCLEON-NUCLEON CORRELATIONS IN THE Li-6, C-16 AND O-16 NUCLEI FROM ELASTIC ELECTRON SCATTERING
A. Malecki (Inst. of Nucl. Res., Krakow) and P. Picchi 26 Jul. 1968 9 p refs
(LNF-68/48) Avail: CFSTI

The applicability of the single correlated pair approximation (s.c.p.a.) has previously been questioned. In this paper, the applicability to the heavier nuclei is examined by performing correlation calculations for Li 6, C 12, and O 16. In the case of

Li 6 it is found that the elastic electron scattering is sensitive to the nucleon-nucleon correlations only at large momentum transfers. In the elastic electron scattering from C 12 and O 16 the short range correlations are less important. The experimental results for these nuclei are fairly well explained in the oscillator shell model without the correlations. The resulting charge form factors are shown in graphs and discussed in the light of findings by other investigators. K.W.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N69-13915 Yale Univ., New Haven, Conn.
NEGATIVE CYCLOTRON RESONANCE ABSORPTION
Johathan Mark Wachtel (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-8864

The cyclotron resonance absorption of microwave energy by monoenergetic electrons which drift through a cavity resonator has been measured in order to verify these predictions. In each case the observed absorption spectra are similar to those calculated in a perturbation theoretical solution of the Boltzmann equation treating the cyclotron resonance interaction between the electron beam and the bounded standing wave fields of the cavity resonator. An experiment which exhibits the radiative response in time of a weakly relativistic, monoenergetic electron ensemble to a short pulse of cyclotron resonance radiation is also described. The radiation calculated in an exact solution of the Boltzmann equation is found to occur in repetitive bursts of diminishing amplitude following the stimulating pulse. Experiment and theory are observed to be in qualitative agreement. Dissert. Abstr.

N69-13922 Pennsylvania Univ., Philadelphia.
SEEDED CESIUM PLASMA DIODES AND THE PENNING EFFECT
Allen Kaufman (Ph.D. Thesis) 1967 223 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-4588

In this research, a theoretical investigation was made of the effects of seeding a cesium plasma diode with mercury or cadmium without the presence of an external light source. A macroscopic phenomenological model based on the principles of conservation of mass, current, and energy was developed for the diode. The positive sheath motive diagram was used for the ignited mode while the negative sheath motive diagram was used for the unignited mode. The electron density-electron temperature relationship of the plasma was calculated using rate equations. A nine level atomic model was used for cesium; a four level atomic model was used for mercury or cadmium. It was found that when the diode is seeded with a one hundred to one ratio of cadmium to cesium, the electron density of the plasma can be increased by as much as a factor of sixty over the electron density in a pure cesium plasma at the same electron temperature. The addition of mercury to the plasma was found to result in little change in the electron density-electron temperature relationship of the plasma. Dissert. Abstr.

N69-13947*# City Coll. of the City of New York.
CASCADE THEORY OF PLASMA TURBULENCE IN A STRONG MAGNETIC FIELD
C. T. Tchen Oct. 1968 30 p refs
(Grant NGR-33-013-034)
(NASA-CR-98600) Avail: CFSTI CSCL 20I

For a quasi-neutral plasma consisting of cold ions embedded in hot electrons, the turbulent motion of the ions can be described by a system of dynamical equations determining the velocity and the electric potential. The system is submitted to a cascade approximation and yields two integral equations determining the two spectral functions. Three transport functions are involved: a transfer function across the velocity spectrum, a transfer function across the potential spectrum, and a production function representing the production of potential energy from kinetic energy and causing an exchange between the two spectra. Solutions are found for the following cases: for a collisionless plasma, for a collisional plasma and for a dilute suspension of charged particles. The Bohm diffusion is found to be valid for a weak turbulence in a collisionless plasma. Author

N69-13988 Princeton Univ., N. J.
KINETIC EQUATION FOR A PLASMA WITH ELECTROMAGNETIC INTERACTION
Hulbert Chen-Shuan Hsuan (Ph.D. Thesis) 1967 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-2487

The kinetic equation with an electromagnetic interaction is studied in elaborate detail through Klimontovich's formulation. The short time behavior of the Fokker–Planck equation is examined to prove the validity of Simon's result. Radiation is also discussed in this formulation. Dissert. Abstr.

N69-14029 Cornell Univ., Ithaca, N. Y.
AN ANALYSIS OF THE POSITIVE COLUMN IN THE PRESENCE OF A MAGNETIC FIELD AND THE STRUCTURE OF COLLISIONLESS SHOCK WAVES
James Benedict Fedele (Ph.D. Thesis) 1968 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-5593

Volume recombination effects in the positive column of a glow discharge of parallel-plate geometry are studied. A systematic analysis of this problem is given, including energy considerations. It is found that volume recombination effects are important only for large currents and large wall separations. The retardation of diffusion due to an applied longitudinal magnetic field is investigated, including the onset of the Kadomstev instability for large magnetic fields. The critical value of the magnetic field for the onset of the instability is determined from a normal mode analysis, and qualitative agreement is found with observations in a cylindrical discharge. Small amplitude waves, jump conditions, and collisionless shock structure are investigated using a first order Chew–Goldberger–Low set of equations. Propagation of small disturbances normal and parallel to an applied magnetic field is investigated; three modes of propagation analogous to the MHD case are found. Dissert. Abstr.

N69-14059# Princeton Univ., N. J. Plasma Physics Lab.
VELOCITY-SPACE EFFECTS IN THE COMPUTER SIMULATION OF STELLARATOR CONFINEMENT
Craig G. Smith and A. S. Bishop Sep. 1968 8 p refs Presented at the Conf. on Numerical Simulation of Plasma, Los Alamos, Sep. 1968
(Contract AT(30-1)-1238; Grant NSF GP-579)
(MATT-648) Avail: CFSTI

A pronounced microinstability has been observed in the course of a guiding-center simulation of axially symmetric toroidal confinement with the self-consistent electric field. The model and choice of values for the problem parameters follow those reported recently at Novosibirsk, with the sole exception that here the density is greater by a factor of ten. In this case, the electric field is larger, although the ratio of potential to kinetic energies remains at about 0.5%. The instability develops in a transient phase during which ions with large drift excursions are lost to the walls and the plasma seeks an equilibrium potential distribution. The evolution of

the potential energy in the m = 2 azimuthal mode displays a high frequency burst prior to decay to an equilibrium level. In the earlier stages, the electron distribution function is observed to have extremely well-defined gaps, independent of the magnetic moment, at parallel velocities 2.0 to 2.5 times thermal velocity. Author (NSA)

N69-14070*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
ELECTRICAL FIELD IN AN MGD-CHANNEL OF A RECTANGULAR SECTION WITH SEMITERMINAL ELECTRODES [ELEKTRICHESKOYE POLE V MGD-KANALE PRYAMOUGOL'NOGO SECHENIYA S POLUBESKONECH-NYMI ELEKTRODAMI]
M. M. Ignatenko Washington NASA Dec. 1968 8 p refs Transl. into ENGLISH from Magnitnaya Gidrodinamika, v. 4, no. 1, 1968 p 80-84
(Contract NASw-1692)
(NASA-TT-F-12010) Avail: CFSTI CSCL 20I

The electrical field is found in a magnetohydrodynamic channel of a rectangular section, two walls of which are semiterminal electrodes, and the other two of which are perpendicular to the direction of the external magnetic field and are insulators. The conducting fluid is assumed to be viscous and incompressible. The solution to the problem is obtained by the Wiener–Hopf method. Author

N69-14114# Oxford Univ. (England). Dept. of Engineering Science.
TRANSPORT THEORY FOR MULTI-COMPONENT PLASMA Interim Research Report
Theo Kahan Jul. 1968 58 p refs
(Grant AF-EOAR-67-33)
(AD-677339; AFOSR-68-2010; REPT-105368) Avail: CFSTI CSCL 20/9

The behavior of a plasma with several components, i.e. a completely ionised (or binary) plasma and a partially ionised (ternary) plasma is studied. The problem is analysed by means of the Boltzmann and Fokker-Planck equations. The methods used by Enskog-Chapman are generalised for the case of the multi-component gas where the different equations are coupled with each other. In particular the question is studied of what becomes of the collision operators when the plasma is made up of several components. When there is a common equilibrium temperature the Enskog-Chapman approach goes through. When the components have different temperatures a system of eigen-functions of the collision operators cannot be found, but expansions in terms of functions akin to the Sonine-polynomials are possible. Another method is sketched which takes advantage of the different orders of magnitude of the various collisional integrals leading to a coefficient matrix which converts the system of coupled equations into a set of integral equations. The binary case is compared with Braginskiis results. The report discusses possible methods for the computation of transport coefficients when the components are not in thermal equilibrium. Author (TAB)

N69-14125# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
MEASUREMENT OF NEUTRON SPECTRA FOR DETERMINING THE DEUTERON VELOCITY DISTRIBUTION IN A LINEAR THETA PINCH [MESSUNG VON NEUTRONENSPEKTREN ZUR BESTIMMUNG DER GESCHWINDIGKEITSVERTEILUNG DER DEUTERONEN AM LINEAREN THETA-PINCH]
H. Paretzke May 1968 65 p refs In GERMAN; ENGLISH summary Supported in part by EURATOM
(IPP-1/83) Avail: CFSTI

A hot deuterium plasma emits fast neutrons from the reaction $D(d,n)^3He$. Their energy spectra measured in qualified directions can give information about the velocity distribution of the reacting deuterons. This is due to the spatial anisotropy of the neutron energy at the reaction resulting from a kind of Doppler effect. The neutron energy spectra were measured here with nuclear emulsion plates side-on, i.e., vertically to the axis, and end-on, i.e., on the axis of the coil, in the ISAR-I theta-pinch experiment. These spectra were used for obtaining details about the strongly anisotropic velocity distribution of the deuterons. The end-on spectrum reflects the apparatus profile on the emulsion plates. This means that the mean energy of Maxwell distributed deuterons parallel to the axis was smaller than about 1 keV. Author (NSA)

N69-14126# Institute of Nuclear Research, Warsaw (Poland).
RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. 2: EXPERIMENTAL SYSTEM "KAKTUS"
Marek Sadowski 1968 33 p refs
(INR-913) Avail: CFSTI

A detailed description of the experimental "Kaktus" system and its operational parameters is presented. Also described are: the spherical experimental chamber, electromagnets creating a spherical multipole magnetic field, auxiliary electromagnets producing a mirror geometry field, and plasma injectors. A description of a vacuum system and current impulse generators, which supply fast gas valves and plasma injectors, is given. An earth system, a shielding arrangement and control systems are also described. The description includes only arrangements requiring additional tests. Author (NSA)

N69-14130# Montreal Univ. (Quebec). Dept. of Physics.
[RESEARCH ACTIVITIES IN THE PLASMA PHYSICS LABORATORY] Activities Report, Oct. 1967–Oct. 1968
Oct. 1968 53 p refs Partly in ENGLISH and partly in FRENCH; ENGLISH summary Supported by the Natl. Res. Council and the Defence Res. Board
(Rept-5) Avail: CFSTI

A study of a multiple grid analyzer was completed, and work is continuing on experimental techniques for a comparative study of this analyzer with a Langmuir probe in plasma. Experiments on the quality factor of a dipole resonant probe were completed. Measurements of phase differences between various plasma parameters in moving striations of a neon discharge showed the existence of two distinct ionization processes. A new method for determining the lifetime of metastable atoms in an active discharge was proposed, and an experiment on the interaction of an electron beam with a circularly polarized wave in a plasma immersed in a uniform magnetic field was conducted. Experimental techniques were developed to establish ion acoustic instability and to verify a theory explaining the observation of enhanced scattering of radio waves from certain ionospheric plasmas. Incoherent scattering of electromagnetic waves by a high temperature plasma was investigated, as well as the influence of negative ions on the scattering process. Author

N69-14272*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
DESCRIPTION OF SPACE SIMULATION EXPERIMENTS UTILIZING PLASMA PRODUCED BY CONTACT IONIZATION
R. G. Quinn 30 Dec. 1968 23 p refs
(Grant NsG-134)
(NASA-CR-98667; SR-331) Avail: CFSTI CSCL 20I

A number of experiments utilizing thermally ionized plasmas for laboratory simulation of terrestrial plasma phenomena are discussed. It is shown that most of the essential features of the dynamics of charged particles trapped in the earth's field can be simulated in the laboratory. Further, it is possible to systematically and in a controlled manner violate the various adiabatic invariants of the motion by causing perturbations through electric and

magnetic fields and collisions. It is also shown that the conditions important for wave phenomena in the earth plasma can be simulated in the laboratory. The size of the experimental apparatus will vary with the particular phenomena one wishes to simulate but even in the largest case is still experimentally feasible. A few clarifying remarks concerning the proper relation of laboratory simulation experiments with theoretical and experimental space research are also made. Author

N69-14325# California Univ., Berkeley. Div. of Aeronautical Sciences.
MAGNETICALLY INDUCED CURRENTS AND THERMOELECTRIC EFFECTS IN A NON-UNIFORM PLASMA STREAM
William F. Dove (Ph.D. Thesis) Aug. 1968 187 p refs
(Contract Nonr-222(45); Grant NSF GK-1297)
(AD-677463; AS-68-5) Avail: CFSTI CSCL 20/9

An experimental and theoretical investigation into the definition and effects of magnetically induced currents in a non-uniform, decaying, partially-ionized gas flow is reported. It is shown that it is possible to explain certain experimental observations if thermoelectric charge transport is included in the constitutive relation between fields and current density. In addition, (1) measured values of the ratio of an effective electron thermal conductivity to the thermoelectric coefficient and (2) experimental conditions suggest that this partially-ionized-gas transport can be adequately explained in terms of the results of fully-ionized-gas transport theory (Spitzer-Haerm). Implicit in this result is the conclusion that the total e.m.f. induced in non-uniform ionized gases includes a direct contribution from the electron energy in addition to the well known motional e.m.f. which derives from the relative motion of conductor and induction field. Author (TAB)

N69-14367 Yale Univ., New Haven, Conn.
LONG-RANGE INTERATOMIC FORCES AND DIVERGENCES IN THE STATISTICAL THEORY OF RADIATIVE PROCESSES IN PLASMAS
Hans Joachim Laue (Ph.D. Thesis) 1967 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-5177

Previous work on the coupling between nuclear and electronic motion in diatomic molecules has led to the prediction of a R^{-2} term in the interatomic potential between atoms at large distances of separation. The present re-examination of this problem shows that the R^{-2}-dependent terms found by Dalgarno and McCarroll cannot be interpreted as an interatomic potential but must be understood as a centrifugal effect connected with a certain rotation of the electron cloud as the vector $\vec{R}$ joining the nuclei rotates. If Prigogine's theory of nonequilibrium statistical mechanics is applied to a plasma interacting with radiation, described by the customary classical Hamiltonian, certain divergences arise. These divergences are shown to be partly a consequence of properties of the Hamiltonian. Dissert. Abstr.

N69-14372# Sydney Univ. (Australia). School of Physics.
WILLS PLASMA PHYSICS DEPARTMENT Semiannual Progress Report, 1 Jan.–30 Jun. 1968
30 Jun. 1968 9 p refs
(PR-15; NP-17625) Avail: CFSTI

A brief discussion of research work at Sydney is presented. NSA

N69-14396# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE DYNAMIC STABILIZATION OF THE Z-PINCH
C. Andelfinger and G. Lehner Mar. 1968 17 p refs Supported in part by EURATOM
(IPP-1/77) Avail: CFSTI

An experiment is described in which a linear Z pinch is stabilized by means of a superimposed high frequency theta pinch. Stability is obtained more easily than would be expected from Weibel's criteria. Future plans for using this method to build a dynamically stabilized screw pinch are discussed. Author (NSA)

N69-14423# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR CONVERSION OF ELECTROMAGNETIC WAVES TO ION-ACOUSTIC PLASMA OSCILLATIONS
V. A. Liperovskiy et al 15 Dec. 1967 9 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 2, 1966 p 116–119
(AD-677228; FTD-HT-23-1106-67) Avail: CFSTI CSCL 20/9

The authors consider the self-consistent problem of conversion of electromagnetic waves with a frequency much higher than the critical frequency to ion-acoustic oscillations in a plasma assuming that a Langmuir wave is generated as the transverse electromagnetic wave decays and that the ion-acoustic wave is then generated by the Langmuir wave. The problem is solved with regard to ion-acoustic wave absorption as well as in the one-dimensional approximation. Examples of two-stage decay are given to illustrate application of the expressions derived in the paper. One-dimensional quasistationary boundary problems are also considered and solutions are given for nonlinear equations which determine the spatial distribution for the number of waves in the spectrum during the decay process. TAB

N69-14459#
CHAPTER 2: PROBE PLASMA INVESTIGATION METHODS
I. M. Podgornyi [1968] 27 p refs Transl. into ENGLISH from the book "Lektsii Po Diagnostike Plazmy" Moscow, Atomizdat, 1968 p 15–41
Avail: CFSTI

Langmuir probe applications for the case of a stationary plasma with a zero magnetic field are discussed. It is pointed out that the theory of Langmuir probes is based on the assumption that charged particles move within a double layer without collisions under the effect of an electric field, and that the applicability of the theory is constrained by values of plasma concentration and temperature when the particle mean free path exceeds the thickness of the double layer. The question of defining plasma parameters from an analysis of probe characteristics is discussed in relation to determining the plasma potential at a given point, the ion concentration which equals the electron concentration to a high degree of accuracy, and the electron temperature. The use of an electrostatic plasma analyzer for measuring ion temperatures is described, along with the use of magnetic probes and pressure balance methods in thermonuclear studies. Two examples are given to show typical errors due to incorrect disposition of the magnetic probe in an axially symmetric adiabatic trap. M.G.J.

N69-14508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW OF A CONDUCTING FLUID IN A CHANNEL WITH A ROTATING MAGNETIC FIELD
Ye. I. Yantovskiy 14 Dec. 1967 10 p refs Transl. into ENGLISH from Izv. Energ. i Transp. Akad. Nauk SSSR, no. 1, 1966 p 151–155
(AD-677225; FTD-HT-23-1102-67) Avail: CFSTI CSCL 20/9

The article is a continuation of previous works in which general equations of magnetohydrodynamics were used for derivation of expressions describing the motion of a conductive fluid in a narrow channel of annular cross section with a rotating magnetic field. This system is numerically integrated in the present paper and results are given showing the distribution of velocity, magnetic field and pressure in the channel as well as indices describing energy transformation as a function of geometric parameters, the magnetic Reynolds number and the Alfven number. Author (TAB)

N69-14525*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL OBSERVATION OF OSCILLATIONS DESCRIBED BY THE CONTINUITY EQUATIONS OF SLIGHTLY IONIZED DEUTERIUM, NEON, AND HELIUM GAS
J. Reece Roth Washington Dec. 1968 58 p refs
(NASA-TN-D-4950) Avail: CFSTI CSCL 20I

Low-frequency oscillations in the electron number density of a slightly ionized gas have been observed in deuterium, neon, and helium over the frequency range from 10^2 to 8×10^4 Hz. These oscillations can be identified with periodic solutions to the neutral- and charged-particle continuity equations. The observed functional dependence of the waveform and of the peak-to-peak amplitude of the oscillation are qualitatively consistent with this mechanism. The frequency of the oscillation was independent of magnetic field strength and had the predicted square-root dependence on the product of electron and neutral number density. Author

N69-14544*# Scripta Technica, Inc., Washington, D. C.
STUDY OF THE FLUCTUATIONS OF A HYDROGEN PLASMA BASED ON THEIR CORRELATION FUNCTION. DISPERSION RELATION [ETUDE DES FLUCTUATIONS D'UN PLASMA D'HYDROGENE A PARTIR DE LEURS FONCTIONS DE CORRELATION. RELATION DE DISPERSION]
M. Bernard, G. Briffod, M. Gregoire, and J. Weisse NASA Dec. 1968 10 p refs Transl. into ENGLISH of Comm. Energie Atomique (Fontenay-aux-Roses), May 1968 15 p
(Contract NASw-1694)
(NASA-TT-F-11921) Avail: CFSTI CSCL 20I

Fluctuation properties of hydrogen plasmas are presented, and the results of the DAPHNIS experiment, in which hydrogen plasma obtained using a coaxial source diffuses along the lines of force of a uniform, static magnetic field, are analyzed. In such an experiment and, more generally, in turbulent plasmas where the fluctuations appear in the form of noise, the mere understanding of the frequency spectrum of the fluctuations does not suffice for the identification of the instabilities associated with them and, consequently, does not permit the identification of the mechanism which is really responsible for the turbulent diffusion. Therefore, a detailed analysis of the properties of the fluctuations is necessary. This study gives, in particular, a better value of the coefficient of turbulent diffusion and better understanding of the frequency spectrum. Author

N69-14607#
INTERFEROMETRIC METHOD OF INVESTIGATING PLASMA IN THE VISIBLE LIGHT RANGE. USE OF LASERS
I. M. Podgornyi [1968] 18 p refs Transl. into ENGLISH from the book "Lektsii Po Diagnostike Plazmy" Moscow, Atomizdat, 1968 p 157–173
Avail: CFSTI

The monochromaticity of laser emission and its high intensity make it a suitable instrument for the interferometric study of high concentration plasmas. A review of lasers used in interferometric plasma diagnostics is presented. Helium neon mixtures are the most common choices for gas lasers to be used since bright lines in both the visible and infrared spectrum ranges are emitted. A ruby pulsed laser has significant advantages over other pulsed light sources in tests on interferometric determination of plasma concentration when its parameters change rapidly. Fabry–Perot interferometers were successfully used with all types of lasers mentioned. A discussion on holography is also presented, as well as using Schlieren photography for plasma diagnostics. B.P.

N69-14613 Vanderbilt Univ., Nashville, Tenn.
SPECTROSCOPIC DETERMINATION OF THE STATE OF A HIGH PRESSURE PLASMA
Terrill Wayne Mayes (Ph.D. Thesis) 1967 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-5421

Using the method of Kerr cell shuttered spectroscopy, the temperature and free electron density of a plasma produced in an electric shock tube has been determined as a function of distance and time by measuring the widths and relative intensities of spectral lines emitted by the plasma. Upon considering the criteria for the establishment of local thermodynamic equilibrium (LTE) in the plasma, it was found that the free electron densities obtained in this experiment are large enough to expect the plasma to be in a state of LTE. A comparison of the temperatures obtained from different chemical elements and ionization stages is consistent with the presence of LTE. Dissert. Abstr.

N69-14672 Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
ON THE NONEQUILIBRIUM NOZZLE FLOWS OF HELIUM AND ARGON PLASMAS
G. Kamimoto and R. Ishii Oct. 1967 33 p refs
(CP-14) Avail: CFSTI

The nozzle flows of weakly ionized plasmas of helium and argon are considered. It is assumed that the plasmas are composed of neutral atoms, singly ionized positive ions and electrons, and the flows are one-dimensional and charge-neutrality is maintained throughout the nozzle. The flows start from nonequilibrium states in energy and ionization. As they flow through the nozzle, electron-ion recombination and adjustment of the temperature difference between the electron gas and the atom–ion gas occur. The change of electron temperature, the degree of ionization and the other flow parameters along the nozzle axis are calculated. The effect of axial heat conduction on the electron gas and the effect of the ambipolar diffusion relative to that of the electron–ion recombination as the electron loss mechanism are also considered. Author

N69-14738# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
ELECTRON DENSITY MEASUREMENTS IN PLASMA JET FLOW WITH MICROWAVE INTERFEROMETRY
G. Kamimoto, T. Kimura, M. Nishida, and N. Horiuchi Oct. 1967 27 p refs
(CP-16) Avail: CFSTI

In argon and nitrogen plasma jet flows, the electron density measurements were made with microwave interferometer. The obtained electron number density in the center of the flow was of the order of 10^{12} 1/cm^3 for argon and in the range from 10^{11} to 10^{12} 1/cm^3 for nitrogen. The former agreed with the results of the Langmuir probe measurements. The phase shift, $\Delta\phi$, of the microwave through the plasma due to the existence of a transient plasma is usually obtained from the output variation of the microwave interferometer, which is called a fringe. In this experiment it was obtained from the direct measurements of the microwave power passed through the each arm of the interferometer as well as the interferometer output. Some discussions were given in order to determine the sign and the integer parts of the phase shift. Author

N69-14824 Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
MEASUREMENTS OF THE ELECTRICAL CONDUCTIVITY IN A PLASMA JET FLOW
G. Kamimoto, M. Nishida, and E. Ohdan Oct. 1967 23 p refs
(CP-15) Avail: CFSTI

The electrical conductivity of plasma jet flow was measured making use of two methods based on different experimental principle, i.e., two electrodes method and transducer method, as a part of experiments of the plasma jet wind tunnel performances. The results for argon plasma with the two electrodes method yield

the electrical conductivity from 0.34 to 1.64 mho/cm and that for nitrogen is from 0.12 to 0.30 mho/cm. And the results obtained with transducer method yield the electrical conductivity from 0.46 to 0.67 mho/cm for argon. The results obtained with two experimental methods are consistent with one another in the order of magnitude. Author

N69-14834# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
THE BEHAVIOUR OF THE CHARGED PARTICLES ACROSS THE NORMAL SHOCK WAVE IN A PARTIALLY IONIZED GAS
Goro Kamimoto, Michio Nishida, and Kazuakira Yoshida Oct. 1967 41 p refs
(CP-17) Avail: CFSTI

The electron temperature and the ion density across the normal shock wave in the nonequilibrium, partially ionized argon were measured by means of the Langmuir probe technique at Mach numbers of 4.17, 4.39 and 4.88. The electron temperature across the shock in the nonequilibrium, partially ionized gas was calculated using the Navier–Stokes equation according to Jaffrin's method and we expanded this calculation to the region of the high degree of the nonequilibrium where he had not tried the calculation. Our calculations were in fairly good agreement with experimental results, excepting the case where the degree of the nonequilibrium was great. Considering the decay of the free-stream ion density, its distribution across the shock was calculated using the Mott-Smith's solution for the neutral atoms, and it was shown that the ion density decrease due to chemical reaction, diffusion, etc. in the free stream had great influence on it. These calculations agreed well with the experimental results, especially in the density ratio. Author

N69-14925# Texas Univ., Austin. Electronics Research Center.
A COMPUTER CODE FOR RECOMBINATION AND DIFFUSION CONTROLLED AFTERGLOWS
Lothar W. Frommhold 20 Aug. 1968 20 p
(Grants AF-AFOSR-766-67; DA-ARO(D)-31-124-G518)
(AD-676992; AFOSR-68-1859; TM-1) Avail: CFSTI CSCL 20/9

A computer code is given for computing the decay of electron densities in a diffusion and recombination controlled disintegrating plasma in finite cylinder geometry. Microwave frequency shifts for TM010 and TE011 modes are derived to be compared with the experimental frequency shifts versus time in order to facilitate accurate evaluation of the electron-ion recombination coefficient. Author (TAB)

N69-14980# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
INTERACTIONS OF LANGMUIR AND ACOUSTIC WAVES IN TURBULENT PLASMA
V. G. Makhan'kov and V. N. Tsytovich 1968 28 p refs In RUSSIAN
(JINR-P9-3978)

Studies of the interactions in fully ionized turbulent plasma show that in case of steady-state and sufficiently broad spectra of intense Langmuir waves such interaction is of destructive character. NSA

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N69-13903 Temple Univ., Philadelphia, Pa.
MOTION OF QUANTIZED FLUX LINES IN HARD SUPERCONDUCTORS IN THE PRESENCE OF TIME-VARYING MAGNETIC FIELDS
David A. Gandolfo (Ph.D. Thesis) 1967 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-4506

Results of three related experiments are presented. They include: 1) effective resistivity which characterizes the mixed state during transmission of small magnetic field steps; 2) field interval between flux jumps in a rapidly varying field; and 3) temperature increase preceding a flux jump. The effective resistivity is observed when, under the influence of a small magnetic field step, the flux bundles begin to move away from the pinning sites, but do not become completely unpinned. The sample remains essentially in the critical state during transmission of the field steps. This resistivity was found to increase as either the size of the field step or the background was increased. In a second experiment, flux jumps occurring at regular intervals were observed in a NbTi sample in superimposed ac and dc fields. Finally, flux jumps in a pressure sintered Nb_3Sn sample were observed, where the sample was brought into a critical state by a slowly increasing dc field, followed by heating with a small amplitude ac field until a single complete flux jump occurred. The results were consistent with the observation that flux jumps occur more readily in the low field regime, where large field gradients, and therefore large current densities, are realized. Dissert. Abstr.

N69-13904 California Univ., Berkeley.
SPIN-ORBIT COUPLING AND NUCLEAR MAGNETIC RESONANCE IN SUPERCONDUCTING METALS
William Alonzo Hines (Ph.D. Thesis) 1967 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-5738

The effect of spin-orbit coupling on the paramagnetic spin susceptibility of conduction electrons in a superconductor was studied by investigating the nuclear magnetic resonance of two groups of samples. In the first group, the residual Knight shift was measured in samples of pure lead particles with average particle dimensions of 120, 270, and 410 Å. Although small particle line broadening occurred, the nuclear resonance was observed, and the residual shift was found to be a function of the particle size, as with previous work on pure tin. In the second series, various concentrations of In, Sb, Pb and Bi impurities were added to tin, and the residual shift was measured. The electronic mean free path was controlled primarily by impurity concentration instead of particle size, and the probability of an electron having its spin flipped in a collision with an impurity is determined by the spin-orbit coupling strength of the scattering center. It was found that a small amount of an impurity with weak spin-orbit coupling has little effect on the residual shift, while the same amount of an impurity with strong spin-orbit coupling increases the residual shift significantly. Dissert. Abstr.

N69-13905 Texas Univ., Austin.
THE COMPLEX REFRACTIVE INDEX OF CALCITE FOR THE REGION OF THE CALCIUM K ABSORPTION EDGE
Richard Economy (Ph.D. Thesis) 1967 112 p
Avail: Univ. Microfilms HC $5.60/Microfilm $3.00 Order No. 68-4279

The reflected x-ray intensity from two calcite crystals in the (1, +1) position and the absorption coefficient of a powdered calcite sample are obtained for a 100 eV region around the calcium K absorption edge. These quantities are converted to the reflection and linear absorption coefficients for the calcite crystals. A relationship between the coefficients and the electronic characteristics of the atoms in calcite is developed and used to obtain a self-consistent set of values for the complex refractive index

of calcite for the region of the CaK edge. A discussion of data smoothing techniques is presented; for statistically poor data a sharp cut-off filter can produce an undulation (or ringing) in the filtered results. From a qualitative treatment of dispersion theory, it is shown that the real refractive index decrement attributed to the CaK electrons is proportional to the slope of the CaK linear absorption coefficient, corroborating the relative structure of the results for the real refractive index decrement. In order to obtain the required data, a continuously-aligned, two-crystal spectrometer was developed which was capable of continuously scanning the large angular regions of the K absorption edges of lighter elements. Dissert. Abstr.

N69-13911 Texas Univ., Austin.
SILICON NITRIDE CONDUCTION MECHANISMS
Jerry Reese Yeargan (Ph.D. Thesis) 1967 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-4365

An investigation of the conduction properties of thin insulating films of silicon nitride as a function of applied voltage, temperature, thickness, contacts and substrate reveals three mechanisms for injecting carriers into the conduction band: two bulk thermal emission mechanisms and field ionization. One thermal mechanism behaves like Schottky emission without electrode effects by exhibiting transient effects in the current measurements, a barrier height of .85 to 1.05 eV, a strong temperature dependence and appropriate variation in current with field. This internal Schottky emission probably arises from non-stoichiometric regions in some of the amorphous films. Other films exhibit steady reproducible measurements at fields of 2 to 8 $\times$ 10^6 v/cm, with a barrier height of 1.5 eV and strong thermal and field influence on the current. These characteristics of the second thermal mechanism follow the Poole-Frenkel model. Field ionization of bulk traps injects the carriers for fields above 8×10^6 v/cm. Dissert. Abstr.

N69-13923 Vanderbilt Univ., Nashville, Tenn.
INVARIANT IMBEDDING AND THE BAND THEORY OF SOLIDS
James Provine Kelley (Ph.D. Thesis) 1967 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-5417

The purpose of this thesis is to apply the method of invariant imbedding to the problem of finding the energy bands associated with one-dimensional models of solids. This is an extension of work by Davies and Denman in which some of the simpler problems of quantum mechanics were solved using invariant imbedding. First, following a wave mechanics approach, the electron is represented by waves traveling in both directions. A scattering matrix is then associated with any potential barrier that the electron may encounter. Several properties of this scattering matrix are discussed, and a criterion is developed by which it may be determined if an electron level is in a permitted region or not. Using the technique of invariant imbedding, a computational method is developed to find the scattering matrix associated with any arbitrary potential barrier. This method was programmed and calculations performed on an I.B.M. 7072 computer. Dissert. Abstr.

N69-13954 Utah Univ., Salt Lake City.
AN ELECTRON PARAMAGNETIC RESONANCE STUDY ON n-TYPE RUTILE
Paul Irving Kingsbury, Jr. (Ph.D. Thesis) 1968 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-5118

The most salient feature of the EPR spectrum of metal-doped (reduced) rutile was studied. This is a narrow pattern for four lines with g values approximately equal to 1.975. It is shown that the source of the spectrum can be identified in a consistent fashion with a Ti^{3+} ion residing in a (1/2, 0, 1/2) site. The consistent model is based on EPR data and computer-calculated point-ion lattice potentials at various sites. The calculated lattice potentials together with Born–Mayer repulsion calculations provided the basis of a theory for diffusion in rutile. The qualitative aspects of the experimentally observed anisotropic diffusion of lithium in rutile were explained by the theory. The equilibrium sites and diffusion properties of titanium, hydrogen, and other alkali ions are also discussed in terms of the theory and known experimental results. Dissert. Abstr.

N69-14006 Purdue Univ., Lafayette, Ind.
THE MAGNETORESISTANCE OF GERMANIUM IN THE HOP CONDUCTION RANGE
William Wei-yen Lee 1966 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-6261

The magnetoresistance of hop conduction was measured employing phosphorous-doped germanium samples having room-temperature carrier concentrations between 7×10^{15} and 1×10^{17} cm^{-3}, and on gallium-doped germanium samples having concentrations between 10^{15} and 10^{16} cm^{-3}. The angular positions of the extrema in the anisotropy curves at low temperatures are independent of the concentration of impurities, and, for P-doped samples, are the same as found for Sb and As-doped material in previous work. A detailed analysis of the temperature dependence of the magnetoresistance of P-doped Ge indicates the presence of conduction due to hopping between 1s(3) states between 4°K and 5°K and due to hopping between D^- levels for intermediate concentrations. An apparent change of current path due to the magnetic field was deduced from the ratio of the longitudinal and transverse magnetoresistances, and attributed to a probable Hall effect. Dissert. Abstr.

N69-14018 Lehigh Univ., Bethlehem, Pa.
GALVANO-THERMOMAGNETIC EFFECTS IN DIRECTIONALLY ALIGNED EUTECTICS
Solomon Musikant (Ph.D. Thesis) 1967 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-4899

The systems studied were the alloys Bi–Zn, Bi–Cd, InSb–Sb and InSb–MnSb. In each case the properties of the aligned eutectics were compared to those of the constituents. The two bismuth eutectics in the second phase solidified in the form of plates and as triangular rods in the InSb–Sb eutectic, while the second phase occurs as fine fibers in the InSb–MnSb alloy. Each alloy was tested in the direction along the ingot growth (longitudinal specimen) and in the direction transverse to the growth (transverse specimen). It was found that in these highly anisotropic materials the resulting properties were very sensitive to orientation. Properties were explained on the basis of the morphological details of the structures. Simple electrical analogs of the structure were found to be capable of qualitative explanation of the resistivity and Seebeck coefficient results. Magnetic effects were correlated with the influence of magnetic field on the mobilities of the electron and hole charge carriers. The effects of grain orientations and grain boundaries on the mobilities of the carriers were considered. Doping effects on the characteristics of the matrices were found to be highly influential in modifying the properties of the composites. Dissert. Abstr.

N69-14022*# Naval Weapons Center, China Lake, Calif.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE PHYSICS OF CRYSTALLINE SURFACES Quarterly Status Report, 1 Aug.–31 Oct. 1968
E. Bauer 31 Oct. 1968 6 p refs
(NASA Order R-05-030-001)
(NASA-CR-98805; QSR-3) Avail: CFSTI CSCL 20B

Results of continuing investigations of the physics of crystalline surfaces are presented. Studies of the relation between the structure

of epitaxial films and surface and interfacial energies, as evidenced by the growth of gold on sodium chloride, centered around determining the necessary parameters for obtaining relatively step-free surfaces for counting. Quantitative studies of the elastic and inelastic interactions of slow electrons with W single crystal surfaces included investigation of the diffraction of plasma scattered electrons at low energies and loss beam mapping measurements. Using a Si(111) surface, studies into the nature and structure of surface layers with low energy electron diffraction were made. Particular emphasis was placed on the influence of inelastic scattering on the penetration depth of the electron beam. Finally, adsorbate influence upon surface structure and work function changes was investigated using a combination of low energy electron diffraction and low energy electron diffraction microscopy with emission microscopy. This technique was made possible by use of the ultrahigh vacuum electron microscope. Author

N69-14031 Virginia Univ., Charlottesville.
RADIATION INDUCED TRANSFORMATION OF AMORPHOUS TO CRYSTALLINE SOLIDS
Carl Matthew Cox, Jr. (Ph.D. Thesis) 1967 245 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.20 Order No. 68-3149

This dissertation describes the radiation-induced crystallization of amorphous films of Ta_2O_5 and Ge at controlled temperatures and atmospheres. It was found by transmission electron microscopy that these amorphous films transform to the crystalline phase upon fast neutron irradiation in the 10^{16} to 10^{17}nvt$_{>1\,Mev}$ range at temperatures 100 to 200°C below the temperatures at which similar effects could be obtained thermally. The phenomenon is strongly temperature dependent, and a 25°C difference in irradiation temperature makes a significant difference in the degree of crystallization. The density of radiation-induced crystallites was found to be proportional to the fast neutron exposure. Dissert. Abstr.

N69-14035 IIT Research Inst., Chicago, Ill.
IONIZING IRRADIATION EFFECTS ON THE FRACTURE SURFACE ENERGY OF POTASSIUM CHLORIDE
Tapan Kumar Bhattacharya (Ph.D. Thesis) 1966 94 p refs
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-3251

The effects of Co-60 gamma-ray and 40 KV X-ray irradiation on the fracture surface energy and external surface energy of potassium chloride single crystals have been investigated. The fracture surface energy was measured by the Obreimov–Gilman slow cleavage technique using the experimental procedure described by Westwood and Hitch. Co-60 gamma-ray irradiation at room temperature causes a decrease in the fracture energy at 300°K and an increase at 115°K. The effects of room-temperature F-light bleaching on the fracture energy of gamma-ray irradiated KCl show that the formation of aggregate centers causes an increase in the fracture energy, the increase being larger when the measurement is done at 115°K. The effect is reversed when the aggregate centers are destroyed by re-irradiation. A theory is developed to account for the observed radiation-induced changes in fracture energy. Dissert. Abstr.

N69-14042# Duke Univ., Durham, N. C.
SUBLATTICE MAGNETIZATIONS IN SEVERAL IRON GARNETS
John Roland Gonano (Ph.D. Thesis) 1967 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-2722

The temperature and magnetic field dependence of the hyperfine field at iron nuclei in several iron garnets has been measured by means of Fe^{57} spin echo NMR. The temperature dependence of the NMR frequencies was observed from 4.2°K to 373°K. The magnetization reversal below 80°K was calculated in terms of spin wave theory. In YIG the magnetic field dependence of the NMR frequencies has been observed below 10 kOe. At 4.2°K the Fe^{57} gyromagnetic ratio was measured: $\gamma/2\pi = 137.4 \pm 0.2$ Hz/Oe. At 63.1°K and 77.6°K the sublattice magnetizations both increase with field in the manner predicted by spin wave theory. For GdIG and TmIG the *a*, *d* and *c* sublattice magnetizations were calculated from the NMR measurements and the known total magnetization. In LuIG a broad spectrum of resonances between about 40 and 78 MHz was observed at 4.2°K. Dissert. Abstr.

N69-14043 Princeton Univ., N. J.
THE EFFECTS OF ELECTRON-ELECTRON INTERACTIONS ON THE OPTICAL ABSORPTION IN METALS
E-ni Foo (Ph.D. Thesis) 1967 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2478

A general formalism for phonon induced optical absorption in metals is derived. It has been applied on solid sodium and liquid sodium and mercury. The lattice of sodium is approximated by a one dimensional model. Its lattice wave vector G is somewhat greater than a k_F, the Fermi wave vector. The energy loss function of such an electron gas for a wave vector q has been calculated. The optical absorption in liquid sodium and mercury have been calculated. The existence of Hopfield resonance has been discussed. The effect of the d-band transition in mercury on optical absorption has been treated in a simple approximation. The Hopfield resonance was found to be shifted from 10.8 to 7 ev. This agrees with the experimental result. The strength of the Drude absorption in liquid sodium was found six times too high. Dissert. Abstr.

N69-14046 State Univ. of Iowa, Iowa City.
THE DE HAAS-VAN ALPHEN EFFECT AND THE FERMI SURFACE OF IRON
Peter Theodore Panousis (Ph.D. Thesis) 1967 167 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-2853

A high-speed digital recording system has been incorporated into the impulsive-field de Haas-van Alphen experiment which, when used with a specially devised computer program, provides a significant increase in the frequency resolution of this experiment and at the same time enormously decreases the time required for analysis of the results. This data recording and analysis system was used to study the de Haas-van Alphen effect in iron whiskers with impulsive fields of up to 220kG. The results have been interpreted in terms of two sets of surfaces, one set for spin-up electrons, which is in fair agreement with band calculations, and another set for spin-down electrons, which differs considerably from the surface predicted by band calculations. This model has been shown to account for the results of recent magnetoresistance and Hall effect measurements in iron. Dissert. Abstr.

N69-14047 Maryland Univ., College Park.
UPPER CRITICAL FIELD OF SUPERCONDUCTING TIN AND LEAD FILMS DISORDERED DUE TO DEPOSITION ON SUBSTRATES HELD AT LOW TEMPERATURE
Richard Wellman Brown (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-3341

Measurements have been made of the parallel magnetic field ("upper critical field") required for resistive onset in films of superconducting tin and lead. These films were initially highly disordered due to deposition on substrates held at liquid helium temperature; measurements were made on the films as deposited, after annealing to temperatures around 100°K, and fully annealed. The degree of annealing was inferred from the residual resistivity after temperature cycling; both tin and lead films show no further decrease in residual resistivity if brought to room temperature. The

results indicate: (a) That the spatial range of a structural (Abrikosov) solution to the Ginzburg–Landau equation is a function of H applied when one is close to the upper critical field. (b) That a film will switch from thin to thick behavior when such a solution in some sense "fits" inside the film. Dissert. Abstr.

N69-14086*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A SUMMARY OF THE MEASUREMENT AND INTERPRETATION OF THE HALL COEFFICIENT AND RESISTIVITY OF SEMICONDUCTORS
D. Michael Stretchberry Washington Dec. 1968 51 p refs
(NASA-TM-X-1711) Avail: CFSTI CSCL 20L

Previously published methods of measuring and interpreting the Hall coefficient and resistivity of semiconductors are summarized. The conventional and van der Pauw methods of measurement are briefly discussed. Mobility is shown to be a function of carrier scattering in a specific semiconductor. The equations for charge carrier concentration are developed for both extrinsic and intrinsic conduction. These equations are then used as the basis for interpreting the measured experimental data. The analysis of the data near the intrinsic range and the temperature range over which the experimental measurements must be made are specified. Author

N69-14089 Michigan State Univ., East Lansing.
THEORY OF AN ELECTRIC-CURRENT-FLOW INDUCED POLARIZATION EFFECT ON THE OPTICAL ABSORPTION OF A SEMICONDUCTOR
Carl Anthony Baumgardner (Ph.D. Thesis) 1967 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-4103

A calculation is made of the direct optical absorption in a current-carrying semiconductor. It is assumed that the only effect of the d.c. electric field which produces the current, is to shift the distribution of carriers in k space. It is found that the absorption depends on the relative orientations of the electric field and the polarization vector of the light. This polarization effect is found to be proportional to the square of the carrier drift. A physical picture of the effect is presented. Curves of the effect versus photon energy are calculated for both fundamental and inter-valence-band absorption in indium antimonide, for both the intrinsic and extrinsic semiconductor, and for various field strengths and temperatures. The results are analyzed and found to be consistent with the physical picture of the effect. Suggestions are made for using the effect to investigate the distribution functions and wave functions of a semiconductor and a comparison is made with a similar effect measured in p-type germanium. Dissert. Abstr.

N69-14096 Cornell Univ., Ithaca, N. Y.
HELICON WAVES, SURFACE MODE LOSS, AND THE ACCURATE DETERMINATION OF THE HALL COEFFICIENTS OF ALUMINUM, INDIUM, SODIUM AND POTASSIUM
John Mott Goodman (Ph.D. Thesis) 1967 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-3502

Observations of helicon wave resonances in some metals have been interpreted by various investigators as implying values for the Hall coefficients of these metals which are significantly higher than the theoretical values. In 1964 Legéndy critically discussed the boundary conditions and gave several solutions. His solution for an infinite cylinder parallel to the static magnetic field is particularly interesting in that it predicts the existence of a surface mode whose total power dissipation is virtually independent of the material's resistivity. This paper presents a detailed quantitative experimental confirmation of this solution's accuracy, thus validating the boundary condition used. The observations also yield values for the Hall coefficients of aluminum, indium, sodium, and potassium which are equal to the theoretical values to within the experimental accuracy of about one-half percent. Dissert. Abstr.

N69-14103*# Scripta Technica, Inc., Washington, D. C.
EXPERIMENTAL STUDY OF THE ELECTRONIC STRUCTURE OF SEMIMETALS AND DEGENERATE SEMICONDUCTORS [ETUDE EXPERIMENTALE DE LA STRUCTURE ELECTRONIQUE DES SEMI-METAUX ET DES SEMI-CONDUCTEURS DEGENERES]
W. Mercouroff (Centre Natl. Rech. Sci.) NASA Dec. 1968 18 p refs Transl. into ENGLISH from the French Rept. Presented at the Simon Fraser School of Solid State Phys., Barnaby, B. C., Canada, 1967
(Contract NASw-1694)
(NASA-TT-F-11953) Avail: CFSTI CSCL 20L

Reviews the literature data on electronic structure of semimetals and degenerate semiconductors, Fermi surface models and the experimental techniques available for their study. Author

N69-14115# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
WAVE MOTIONS IN SOLIDS WITH LAMELLAR STRUCTURING
Jan D. Achenbach and George Herrmann Aug. 1968 50 p refs
(Contract Nonr-1228(34))
(AD-677325; TR-68-3) Avail: CFSTI CSCL 20/11

The dynamic behavior of an unbounded medium with lamellar structuring shows a marked dependence on the ratio of the wave length and a length characterizing the layering of the medium. In this paper the time-harmonic vibrations of a laminated medium are analyzed both by employing the equations of the theory of elasticity for each layer, and by employing an approximate continuum theory for the layered medium. The frequency equations, which indicate a notable dispersive behavior, are determined according to the exact and approximate theories. A comparison of the exact and approximate frequency-versus-wavenumber curves shows good agreement. The propagation of time-harmonic waves in a laminated plate is then studied by means of plate equations based on the continuum theory for the layered medium. The dispersion curve for flexural motion is compared with an exact curve, and it is observed that both curves show like qualitative behavior, which is characterized by increasing phase velocities as the wave number increases. By contrast, a corresponding curve based on a continuum theory which does not take into account the lamellar structuring of the plate shows a constant phase velocity beyond a certain wave number. Author (TAB)

N69-14116# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
MICROPOLAR ELASTIC SOLIDS WITH STRETCH
A. Cemal Eringen Jun. 1968 29 p refs
(Contract N00014-67-A-0151-0004)
(AD-677324; TR-4) Avail: CFSTI CSCL 20/11

The equations of motion, constitutive equations, and boundary conditions are derived for a class of micropolar elastic solids which can stretch and contract. These solids respond to intrinsic rotational motions and spin inertia and therefore can support couple stresses and body couples. In addition, dipolar microelements of such solids can undergo axial intrinsic motions. The model introduced is conjectured to explain the motions of certain classes of granular and composite materials in which grains and fibers are elastic in the direction of their major axes. The consequence of the instability restrictions arising from the requirements of a nonnegative internal energy is studied in detail, and field equations are obtained for the mass density, microinertia, microrotation vector, and the microstretch. Two theorems of uniqueness and an energy theorem are proved. Author (TAB)

N69-14199 Brown Univ., Providence, R. I.
LOW ENERGY ELECTRON DIFFRACTION STUDIES OF (0001) SURFACES OF CdS AND ZnO
Bruce Duncan Campbell (Ph.D. Thesis) 1967 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-1443

Atomically clean (0001)Cd and (000$\bar{1}$)S surfaces of CdS and (0001)Zn surfaces of ZnO were obtained by argon ion bombardment and annealing. On the (0001)Cd surface of CdS, the presence of intense half integral order diffraction beams indicated a surface unit mesh with dimensions twice those of the ideal bulk lattice. A double spaced structure was also found on the opposite (000$\bar{1}$)S surface after initial ion bombardment (250V, 20uA/cm^2, 10 min) and annealing (400°C, 1 hr). On further ion bombardment and annealing, the pattern was replaced by one arising from |10$\bar{1}$4| planes inclined to the (000$\bar{1}$)S surface. Heating near 800°C formed |10$\bar{1}$3| planes. These thermal etch facets were very stable and could be removed only by mechanical polishing. The (000$\bar{1}$)Zn surface of ZnO exhibited a surface unit mesh with dimensions equal to those of the bulk lattice. There was no evidence of fractional order diffraction beams. Dissert. Abstr.

N69-14209 Wisconsin Univ., Madison.
THE SUPERCONDUCTIVE TUNNEL JUNCTION NEURISTOR
Robert Dana Parmentier (Ph.D. Thesis) 1968 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-5342

Neuristor devices are of interest as the basic component of an artificial nervous system. A strip transmission line which utilizes electron tunneling through a thin insulator separating two superconducting metals can support propagation of neuristor pulses. Such superconductive neuristor lines are of two distinct types: (1) normal electron tunnel junction lines, in which the insulating layer is 30–50 Å thick, and (2) Josephson junction lines, in which the insulating layer is 10–20 Å thick. Dynamic steady state analysis applied to the nonlinear partial differential equations which describe the normal electron tunnel junction line predicts the pulse propagation velocity (through Bendixson's criterion) and gives upper and lower bounds both for the bias current required for neuristor propagation and for the voltage amplitude of the neuristor pulse (through Poincaré's index rule).

N69-14229*# Techtran Corp., Glen Burnie, Md.
ON THE PROBLEM OF TIME EQUIVALENCE OF IRRADIATION [PROBLEME DE L'EQUIVALENCE EN TEMPS D'UNE IRRADIATION]
A. Roizes Washington NASA Dec. 1968 14 p refs Transl. into ENGLISH from French Report CERTS-NT-02-09
(Contract NASw-1695)
(NASA-TT-F-12046; CERTS-NT-02-09) Avail: CFSTI CSCL 20L

The distribution of defect centers in crystals depends not only on impurities, but also on thermal cycle and energy of the radiation. Different factors that can influence the defect center distribution are analyzed in the temperature range −100°C to +100°C. It is shown that with better knowledge of the recovery process it would be possible to simulate long irradiation times with reasonable operation time of a particle accelerator. Author

N69-14234# General Electric Co., Schenectady, N. Y. Research and Development Center.
CHEMICAL DYNAMICS ON CRYSTAL SURFACES Final Technical Report, 1 Feb.–31 Jul. 1968
Gert Ehrlich Aug. 1968 7 p refs
(Contract F44620-68-C-0050)
(AD-677302; S-68-1125; AFOSR-68-2308) Avail: CFSTI CSCL 20/12

Molecular beam studies with hydrogen have uncovered a mechanism for promoting the interaction with a semiconductor surface through stimulation of the gas stream alone. Field emission observations of an atomically smooth f.c.c. metal have been carried out. These reveal a pronounced structural specificity for inert gases--rough, index planes are preferred both in van der Waals and in weak chemical interactions. Author (TAB)

N69-14269# Los Alamos Scientific Lab., N. Mex.
THE CONDITIONS FOR THE EXISTENCE OF THE LAVES PHASES IN INTERMETALLIC SYSTEMS
Bernard del Litto [1968] 26 p refs Transl. into ENGLISH from the French Rept. CEA-BIB-92
(LA-TR-68-35) Avail: CFSTI

A definition is given of Laves phases, and their structures and distribution are discussed. The factors that determine the existence and structure of the Laves phases are studied including size factor and electronic concentration. Available thermodynamic data are tabulated, and the interpretation of the Laves phases is discussed. Author (NSA)

N69-14327# Brookhaven National Lab., Upton, N. Y.
SUMMARY OF SIXTH WEEK OF 1968 SUMMER STUDY
J. P. Blewett [1968] 6 p Presented at Summer Study on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.–19 Jul. 1968
(BNL-12831; CONF-680621-8) Avail: CFSTI

The proceedings of the sixth week of 1968 summer study at Brookhaven are described. The topics discussed included superconducting synchrotrons, the FFAG, energy storage in superconducting magnets, and radiation effects on superconducting magnets. NSA

N69-14394# Stanford Linear Accelerator Center, Calif.
TRANSMISSION SECONDARY EMISSION FROM THIN FILMS OF ALKALI HALIDES
Jorge Llacer Aug. 1968 186 p refs
(Contract AT(04-3)-515)
(SLAC-86) Avail: CFSTI

The phenomenon of secondary emission from alkali metal halides has been studied theoretically and experimentally in substantial detail. Transmission type measurements have been chosen, rather than reflection, because the former method gives one more parameter (thickness) for comparisons between experiments and theory. The energy loss suffered by primary electrons is obtained from published experimental results of electron scattering by thin foils. The escape of low-energy electrons (.25 to 7.5 eV) is studied in detail using time-dependent perturbation theory. The resulting transport problem is solved with the exact scattering probability distribution by a Monte Carlo method. It is shown that for low-energy electrons generated isotropically inside a solid, an exponential probability of escape exists. Escape parameters and energy losses are computed for CsI, KCl, NaF, and LiF, representing alkali metal halides from the highest to lowest Z. The experimental yield of films of those four materials, for thicknesses of 125 to 1000 Å, has been measured by a pulsed method. The energy distribution of emitted electrons for the same materials has also been measured, making certain that the films remained uncharged. A Kelvin probe was used to establish that fact and also to determine a true zero of contact potential difference between collector and emitter. A mathematical model of secondary emission based on the detailed theoretical results is proposed and found to agree well with the experiments. Approximate internal excitation functions and composite escape functions for secondaries are computed. The results show that perturbation theory gives good quantitative values of escape parameters and that secondary emission from alkali halides is mainly determined by the energy losses suffered by

primaries and by the electron–phonon interaction of the internal secondaries. A high atomic number is favorable for both mechanisms and the difference between the yields of extreme materials like CsI and LiF is quite understandable. Author (NSA)

N69-14432# Stanford Univ., Calif. Stanford Linear Accelerator Center.
RADIATION EFFECTS ON SUPERCONDUCTING MAGNETS
H. Brechna Aug. 1968 54 p refs Presented at the 1968 Summer Study on Superconducting Devices and Accelerators, BNL, 10 Jun.–19 Jul. 1968
(SLAC-PUB-469) Avail: CFSTI

Based on simplified models and approximations, induced radioactivity in superconducting coils due to high energy particles is calculated. The effects of irradiation on a few commercially available superconductors of Type 2 are presented. Physical and mechanical changes of metals, insulations and helium due to nuclear irradiation are discussed. Author

N69-14469# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
A STUDY OF DISLOCATION MOBILITY AND DENSITY IN METALLIC CRYSTALS Annual Summary Report for Period Ending Jul. 1968
T. Vreeland, Jr. and David S. Wood Aug. 1968 10 p refs
(Contract AT(04-3)-473)
(CALT-473-28; ASR-6) Avail: CFSTI

A review of research conducted to determine the role of dislocation dynamics in the plastic deformation of crystalline solids, particularly single crystals of Fe, Mo, Al, Nb, and Zn, is presented. NSA

N69-14532 University of Southern Calif., Los Angeles.
ELECTRON BEAM EXCITATION OF SEMICONDUCTORS AND A STUDY OF CATHODOLUMINESCENCE WITH AN ELECTRON MICROPROBE
David Franklin Kyser (Ph.D. Thesis) 1967 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilms $3.00 Order No. 68-5867

A quantitative basis is established for electron beam excitation of semiconductors with regard to the spatial distribution of excess carriers. The distribution of x-ray production used in quantitative electron probe microanalysis forms a basis for the distribution of excess carrier production by electron beams in the range 5–50 keV. The theory includes surface recombination as well as transients in the carrier recombination rate. An important example is given for the steady state distribution in depth of excess hole density produced by a 29K 29keV beam in n-GaAs using a 1-dimensional Gaussian source with appropriate material constants. Extension of the theory to other voltages and materials is given. The transient recombination rate of excess carriers produced by a delta-function or step-function electron beam source in time cannot be represented by a single exponential decay or rise, respectively. The transient recombination rate depends on the beam voltage and the ratio of the surface recombination velocity and the diffusion velocity of the excess minority carriers. Dissert. Abstr.

N69-14534# Brookhaven National Lab., Upton, N. Y.
OBSERVATIONS OF FLUX JUMP BEHAVIOR RELATED TO VARIOUS CHANGES OF GEOMETRY, AND THERMAL AND ELECTRICAL ENVIRONMENT
A. D. McInturff [1967] 10 p refs Presented at Conf. on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.–19 Jul. 1968 Supported by AEC
(BNL-12842; CONF-680621-9) Avail: CFSTI

Hysteresis curves were plotted for superconducting magnets with various geometries and in various thermal and electrical environments. These curves yielded information on flux jump behavior due to changes in geometry, or in thermal and electrical environment. NSA

N69-14537 Rensselaer Polytechnic Inst., Troy, N. Y.
THE SOLID STATE OF POLYOXYMETHYLENE
Michael Jaffee (Ph.D. Thesis) 1967 240 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-6980

A comparative study of the melting behavior, heat of fusion, density and refractive index of polyoxymethylene in different crystalline morphologies was performed. Extended chain crystals were produced by the simultaneous polymerization and crystallization of the monomer, either trioxane or formaldehyde. It was found that the chemically initiated polymerization of trioxane in the solid state led to the most perfect of such crystals, which were fibrous in habit. Spherulites of varying perfection were formed by crystallization from the melt at different cooling rates. Single crystals, hedrites and dendrites were obtained by crystallization from dimethylformamide solution. The effect of polymer concentration, molecular weight and degree of supercooling on solution crystallization was also investigated. All morphologies were characterized by optical microscopy, electron microscopy, and low and wide angle X-ray diffraction. Dissert. Abstr.

N69-14545 Purdue Univ., Lafayette, Ind.
FARADAY ROTATION IN P-TYPE SEMICONDUCTORS
Teh-Hsuang Lee (Ph.D. Thesis) 1967 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-6328

P-type germanium, gallium arsenide, gallium antimonide, indium arsenide and zinc telluride from the neighborhood of intrinsic absorption edge up to 20 microns were investigaed. The observed wavelength dependence of Faraday rotation is quite different form the λ^2 relation expected for the free carrier effect. The spectrum shows maxima and minima resulting from electron transitions between various sets of Landau levels which are associated with the two degenerate hole bands and the spin-orbit band. At long wavelengths, transitions between levels associated with different holes bands are important. In ZnTe, a different spectrum is observed at low temperature which is produced by the holes bound to impurities. The dependence of Faraday rotation on carrier relaxation time was studied for germanium. The magnitude of rotation is found to decrease with decreasing relaxation time. Dissert. Abstr.

N69-14547 Oregon State Univ., Corvallis.
LONGITUDINAL MAGNETORESISTANCE OF SINGLE-CRYSTAL MERCURY
Frederick Roland Fickett (Ph.D. Thesis) 1968 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-6003

The longitudinal magnetoresistance of single crystals of mercury is investigated experimentally, both in the low field and the high field regions. The variation of the magnetoresistance with crystal purity, orientation, size and temperature below 4.2°K is presented. In the low field region the data are discussed in terms of existing theory. The data in the high field region are treated following the ideas of Pippard in terms of a simplified model of the mercury Fermi surface. Agreement of the experimental data with the model calculations is found to be quite good considering the simplicity of the model. The results of an experimental investigation of the zero field resistance of the mercury crystals from 1.8°K to the melting point are also presented. Observed deviations from the Bloch-Grüneisen law at low temperatures and near the melting point are discussed. An anomaly is observed in the resistance versus temperature curves near 4.2°K. A possible explanation of this behavior is presented. Dissert. Abstr.

N69-14585*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRICAL RESISTIVITY AS A FUNCTION OF DEUTERIUM CONCENTRATION IN PALLADIUM
Gust Bambakidis, Robert J. Smith, and Dumas A. Otterson Washington Dec. 1968 17 p refs
(NASA-TN-D-4970) Avail: CFSTI CSCL 20L

The electrical resistivity of the palladium-deuterium system was measured to a deuterium- to palladium-atom ratio of 0.9 at temperatures of 273, 77, and 4.2 K. The resistivity ratio $\rho(x)/\rho(0)$ was plotted as a function of the atom ratio x at 273 and 4.2 K. A modification of Mott's model for the resistivity of transition-metal alloys was used to calculate the structural resistivity. A good fit to the data at 4.2 K was obtained by assuming that the number of d-holes per palladium atom takes on the value of 0.55 to 0.60 on addition of deuterium. Author

N69-14590 Virginia Univ., Charlottesville.
AN INVESTIGATION OF SOME PROPERTIES OF THREE DIMENSIONAL VOIDS IN FACE CENTERED CUBIC METALS
Julius Alfred Sigler, Jr. (Ph.D. Thesis) 1967 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-3125

An experimental method of investigating very small changes in the density of a bulk metal specimen is refined to the extent that relative density changes as small as 5×10^{-6} can be detected. The experiment is applied to measure the relative density change as a function of strain for the case of gold. The purpose of the experiment was to test the hypothesis that small voids are present in furnace-cooled gold and that the collapse of such voids would cause the density to increase slightly with small strains. No such initial increase in density was observed, and in fact, the density sharply decreased initially, probably due to the formation of voids at grain boundaries. A model to describe the method of collapse of voids was also presented. The model, although crude, gives good semi-qualitative agreement with experimental observation in that it predicts that voids should collapse more readily in nickel than in gold. Dissert. Abstr.

N69-14605# Brookhaven National Lab., Upton, N. Y.
USE OF SUPERCONDUCTORS IN HIGH ENERGY PHYSICS
J. P. Blewett [1967] 7 p refs Presented at Conf. on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.–19 Jul. 1968 Supported in part by AEC
(BNL-12832; CONF-680621-5) Avail: CFSTI

Possible uses of superconductors in high energy physics, including beam transport magnets, magnets for bubble chambers, spark chambers, and spectrometers are described. NSA

N69-14609 California Univ., Berkeley.
AN INVESTIGATION OF THE EFFECTS OF ELECTRON IRRADIATION ON THE METAL-OXIDE-SEMICONDUCTOR SYSTEM
Noel Charles MacDonald (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-5782

A theory is developed which explains electron-beam-induced charge-storage effects observed in metal-oxide-semiconductor structures. A steady-state charge distribution is derived, based on a constant density of traps/unit energy, K_t, in the forbidden region of the oxide. This steady-state-induced charge density decreases exponentially from the oxide-semiconductor interface with a characteristic length $x_1 = (\epsilon_{Ox}/q^2K_t)^{1/2}$, and predicts the observed linear relationship between the steady-state field at the oxide-semiconductor interface and the gate voltage during bombardment V_{GB}. A sheet-charge transient analysis of the charge-transport phenomena in the oxide under electron-beam bombardment is also developed. This analysis has two parameters, x_1 and τ_c, where the charging time constant τ_c is independent of V_{GB}, and depends only on the energy loss/unit distance of the primary electron beam in the oxide. Most aspects of this analysis are verified by detailed experiments. Dissert. Abstr.

N69-14637# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
SELF-CONSISTENT OPW AND EMPIRICALLY-REFINED OPW ENERGY BAND MODELS FOR CUBIC ZnS, ZnSe, CdS, AND CdSe
D. J. Stukel (Wright-Patterson AFB), R. N. Euwema (Wright-Patterson AFB), T. C. Collins (Wright-Patterson AFB), F. Herman, and R. L. Kortum [1968] 54 p refs Submitted for Publication
(Contracts AF 19(628)-5750; AF 33(615)-5072)
(AD-677026; LMSD-9-87-68-3) Avail: CFSTI CSCL 20/12

First-principles OPW energy band calculations have been carried out for cubic ZnS, ZnSe, CdS, and CdSe using a non-relativistic formalism and Slaters free-electron exchange approximation. The calculations were first carried out in terms of a physically realistic trial crystal potential, and then iterated to obtain a self-consistent solution. In spite of the simplified treatment of exchange effects, and the neglect of relativistic and correlation effects, the first-principles solutions are in qualitative and semi-quantitative agreement with experiment in all cases. It is shown briefly how improved solutions can be obtained by introducing small, carefully chosen empirical corrections. The adequacy of various energy band models was tested by calculating the optical spectrum (actually epsilon sub 2) and comparing this with the experimental spectrum. Author (TAB)

N69-14674 Duke Univ., Durham, N. C.
CRYSTALLITE ORIENTATION DISTRIBUTION FOR BIAXIALLY STRETCHED POLYETHYLENE
Tomio Adachi (Ph.D. Thesis) 1967 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-5210

Two biaxially stretched polyethylene films were crystallized in the strained state, and diffraction measurements of twelve or thirteen planes were performed for each. The required plane-normal distribution functions were obtained from the diffraction data after corrections were applied for absorption, background scattering, and variation of the irradiated volume. The series termination error is practically negligible for the plane-normal distribution function and seems to be fairly small for the crystallite orientation distribution function when terms with l up to sixteen were retained. Concerning the crystallite orientation of the two polyethylene samples studied, it was found that the crystallographic b-axis is perpendicular to the film plane in both cases. The sample having stretching ratios 1.6 × 1.7 exhibited a random distribution of the a- and c-axes about the b-axis. Dissert. Abstr.

N69-14682# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
OPTICAL THIRD ORDER MIXING IN GALLIUM ARSENIDE, GERMANIUM, SILICON, AND INDIUM ARSENIDE Interim Technical Report
J. J. Wynne Aug. 1968 34 p refs
(Contract N00014-67-A-0298-0006; ARPA SD-88)
(AD-677036; TR-568) Avail: CFSTI CSCL 20/12

Nonlinear optical difference mixing of CO2 laser radiation is studied in the semiconductors GaAs, Ge, Si, and InAs. The fourth-rank electric susceptibility tensor receives independent contributions from the bound or valence electrons, chi superscript b, and, in n-type material from the conduction electrons, chi superscript n. These two contributions are separated and measured in GaAs. Chi superscript b is found to be anisotropic and chi superscript n is isotropic for carrier concentrations n = or < 5 x 10 to the 18th power/cc. The relative signs of the susceptibilities are determined. Chi superscript b in Ge and GaAs, and chi

superscript n in GaAs and InAs all have the same sign for the particular frequency combination studied. Theoretical and experimental evidence indicate that this sign is positive. At room temperature chi superscript n in GaAs in a linear function of n for n = or < 5 x 10 to the 16th power/cc. The value of the slope, the partial derivative of chi superscript n with respect to n, is a direct measure of the nonparabolicity of the conduction band in GaAs. It is shown to be inconsistent with Kanes model for small direct band gap semiconductors, and in agreement with Cardonas indirect measurements of the nonparabolicity in GaAs. Author (TAB)

N69-14791# Army Electronics Labs., Fort Monmouth, N. J.
LATTICE COMPONENT OF THERMAL CONDUCTIVITY IN METALS, ALLOYS, AND SEMICONDUCTORS
Irving N. Greenberg Sep. 1968 49 p refs
(AD-677379; ECOM-3026) Avail: CFSTI CSCL 20/12

The report discusses the lattice component of thermal conductivity in metals, alloys, and semiconductors and the influence affecting it. Phonon scattering processes are described by a relaxation time. The lattice component is expressed in terms of the intrinsic electronic component of thermal conductivity. The residual thermal resistivity is also considered. The influence of the ideal or intrinsic electronic thermal resistivity and that of the residual thermal resistivity on the total thermal conductivity is discussed. A rather detailed discussion is given of the methods of separating the measured thermal conductivity into the electronic and lattice components. The intrinsic lattice component of thermal conductivity and influences affecting it are considered rather completely. A fairly exhaustive treatment of the effect of crystal imperfections on the lattice thermal conductivity is given. Author (TAB)

N69-14792# Army Electronics Labs., Fort Monmouth, N. J.
ANALYSIS OF NON-FICKIAN DIFFUSION DATA USING THE INTERSTITIAL-SUBSTITUTIONAL EQUILIBRIUM MODEL
David W. Yarbrough Sep. 1968 46 p refs
(AD-677380; ECOM-3016) Avail: CFSTI CSCL 20/12

A refinement of the Interstitial-Substitutional Equilibrium Model is proposed in which the concentration of holes in the host crystal is replaced by hole activity. The result is a refined model in which the diffusion coefficient is proportional to a power of the diffusant concentration. Unlike past approaches, however, the introduction of hole activity relaxes the restriction that the concentration exponent be an integer. Generalized numerical solutions are presented for a range of concentration exponents. Analyses based on the refined model have been completed using experimental data from the literature for Zn in GaAs, Cu in GaAs, Sb in Ge, and P in Si. In each case, the data reviewed was labeled anomalous or non-fickian. In general, good agreement was found between computed profiles and experimental profiles using two adjustable parameters. A mathematical criterion for computing the deviation of a computed profile from an experimental profile was established and a wide range of parameters was examined. Parameter values corresponding to minimum deviation of computed from experimental data were recorded for each of the data sets examined. Author (TAB)

N69-14799*# California Univ., Berkeley. Dept. of Mechanical Engineering.
PREDICTIONS OF THE TOTAL EMISSIVITY OF METALS AT CRYOGENIC TEMPERATURES
G. A. Domoto, R. F. Boehm, and C. L. Tien Jul. 1968 21 p refs Presented at the 1968 Cryog. Eng. Conf. *Its* Paper No. K-3
(Grant NGR-05-003-285)
(NASA-CR-73264; TS-68-5) Avail: CFSTI CSCL 20L

Predictions of the total emissivity of metals at cryogenic temperatures based on the anomalous skin effect theory (the ASE theory) are considered. An exact numerical result as well as an approximate expression has been developed to represent the spectral emissivity of metals at cryogenic temperatures. The two representations of spectral emissivity after appropriate integrations over wavelength result in, respectively, a closed-form expression and an exact numerical tabulation of total normal emissivity in terms of three dimensionless parameters. These results are then compared with the existing experimental data of the low-temperature total emissivity of metals and with the prediction obtained from the exact numerical integration of the spectral emissivity as given by the Drude single (or free) electron theory (the DSE theory). The comparison reveals the enhanced accuracy of the ASE theory in predicting the radiation properties of metals at cryogenic temperatures. Author

N69-14949# Eidgenossische Technische Hochschule, Zurich (Switzerland).
GROWTH AND NATURE OF GERMANIUM THIN FILMS FORMED ON GERMANIUM SINGLE-CRYSTAL SUBSTRATES BY EVAPORATION AND CONDENSATION IN VACUUM
Trevor Paul Woodman (Ph.D. Thesis) 1968 127 p refs *Its* Dissertation No. 4092
Avail: CFSTI

The epitaxy of germanium on itself was investigated as a basis for establishing relationships between the physical properties of films and the conditions under which they were formed. Films, ranging from 500 Å to 18,000 Å, were deposited on polished and etched single-crystal germanium having surfaces parallel to (111) by evaporation and condensation in vacuum. The substrate temperatures were ≈ 50°C and 320° to 870°C. The films were examined by high energy reflection electron diffraction (crystalline state), optical microscopy (large area surface topography), multiple-beam interferometry (film thickness), electron microscopy of surface replicas (small area surface topography), and selective etching, followed by optical microscopy (determination of fault density and type). The findings show: (1) In the predominantly single crystal films for deposition temperatures above 400° C, twin lamellae, stacking faults, and dislocations were observed. Contamination of substrate surfaces is believed to be the cause. (2) Electron microscopy of surface replicas revealed that the 500 Å films deposited at 360° C were continuous, whereas at 400° and 470° C the deposit was in the form of islands. M.G.J.

N69-14982# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF THE PHYSICS OF SOLIDS [PROBLEMY FIZIKI TVERDOGO TELA]
E. V. Trushin 9 Nov. 1967 8 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), v. 36, no. 4, 1966 p 149–150
(AD-674348; FTD-HT-23-983-67) Avail: CFSTI CSCL 20/12

A seminar on the main trends of development of modern solid-state physics was called together in December 1965 by the scientific council for comprehensive study of solid state physics of the academy of sciences SSSR jointly with VDNKH, prominent scientists of the union and republic academies, universities, and higher institutions of learning as well as representatives of the industry participated in the seminar. Altogether some 240 people, an exhibit of physics equipment was held in conjunction with the seminar. TAB

N69-14999# Columbia Univ., New York. Dept. of Civil Engineering and Mechanics.
CRYSTAL LATTICE THEORY OF TORSION OF A RECTANGULAR BAR OF SIMPLE CUBIC STRUCTURE

R. D. Mindlin Aug. 1968 16 p
(Contract Nonr-4259(13))
(AD-677042; TR-12) Avail: CFSTI CSCL 20/2

In this paper, there is described an exact, closed solution of the Gazis-Herman-Wallis difference equations of a simple cubic crystal lattice for the case of torsion of an elastic bar of rectangular cross section. Examples are worked out for increasing numbers of particles in the cross section and various ratios of width to depth of cross section until the pattern of the warping function from de St. Venants continuum solution is established. The displacement of each particle, characterizing the warping function, is given as a simple ratio of integers times the product of the angle of twist per unit length and the square of the distance between nearest neighbor particles. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N69-14067 Virginia Polytechnic Inst., Blacksburg.
A STUDY OF THE APPLICATION OF MICROWAVE TECHNIQUES TO THE MEASUREMENT OF SOLID ROCKET PROPELLANT BURNING RATES
Walter Fenton O'Brien, Jr. (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-5565

Results of analytical and experimental studies of a Doppler microwave technique for burning rate measurement of solid rocket propellants are reported. The results showed that the burning rate of solid rocket propellants may be accurately measured employing Doppler microwave techniques, under actual rocket motor combustion conditions. Continuous burning rate information was shown to be contained in the microwave signal, but amplitude and level variations in the received signal masked this information and caused serious data reduction problems. Collimation of microwaves in solid propellants for local burning rate measurement was shown to be feasible. In a small end burning rocket motor severe distortion of the burning rate data signal occurred in the absence of a properly designed collimator. The solid rocket propellants tested were found to be lossy dielectric materials, producing an average loss of 2.8 db per centimeter of propellant in the path of 30 GHz microwaves. Dissert. Abstr.

N69-14118# United Technology Center, Sunnyvale, Calif. Research and Advanced Technology Dept.
RESEARCH ON COMBUSTION OF SOLID PROPELLANTS Final Report, 20 Apr. 1965–31 Aug. 1968
Robert S. Brown and Ray J. Muzzy Sep. 1968 128 p refs
(Contract DA-04-200-AMC-968(X))
(AD-677399; UTC-2136-FR) Avail: CFSTI CSCL 21/9.2

A study was made to relate theoretically predicted and experimentally observed pressure-coupled combustion instability behavior of solid propellants. Using a generalized theoretical model which incorporates both surface and gas phase combustion effects, the linear and nonlinear (higher pressure amplitude) region has been characterized by a group of combustion parameters. Concurrent experimental studies were directed toward investigating (1) the effects of coating the solid oxidizer crystals, (2) the chemical and physical nature of the propellant binder, catalysts, and crosslinking agents on the acoustic admittance, (3) nonlinear response properties, and (4) propellant burning rate. The data show that small changes in propellant formulations can have a significant effect on the derived parameters characterizing the surface and, therefore, on relative contributions of these reactions to the acoustical response properties. Author (TAB)

N69-14302# Los Alamos Scientific Lab., N. Mex.
SOLID SOLUTION OXIDE FUELS FOR SPACE ELECTRIC POWER HEAT SYSTEM
J. A. Leary [1968] 8 p Presented at Potential Contractors Conf. on NAVSAT, Albuquerque, N. Mex., 4 Jun. 1968
(Contract W-7405-ENG-36)
(LA-DC-9686; CONF-680626-1) Avail: CFSTI

A brief review of progress in the development of solid solution oxide fuel disks for power systems in space vehicles is presented. Phases discussed include crystallographic structure, preparation from powders, chemical composition, compatibility, power densities, and physical properties. NSA

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N69-14064*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
HYDRAZINE ELECTROLYSIS FOR SPACECRAFT PROPULSION. ANALYSIS AND TEST OF A DUAL-MODE GAS AND LIQUID SYSTEM Final Report
W. W. Butcher, R. M. Lodwig, W. H. Jones, and N. E. Morgan Aug. 1968 130 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951720)
(NASA-CR-98636; SSD-80316R) Avail: CFSTI CSCL 21H

A continuation of studies on the dual-mode hydrazine spacecraft propulsion system is presented. The three tasks undertaken were: a laboratory and analytical study of the electrolysis of hydrazine, fabrication and test of a breadboard hydrazine electrolysis cell, and design of a prototype dual-mode hydrazine propulsion system. The laboratory studies indicated there are no fundamental problems in the electrolysis process. The breadboard cell was tested as part of a tank assembly that had provisions for gas generation and expulsion in a zero gravity environment. Design verification tests at normal gravity showed gas expulsion capability was independent of tank attitude. A small amount of liquid was entrained in most gas expulsion events, but this defect is believed to have been corrected. One other problem was encountered: a slow decrease of current with operating time; alteration of anode geometry should eliminate or greatly reduce this effect. Additional tests to define operating limits of the existing hardware are planned. Author

N69-14079*# Hughes Aircraft Co., El Segundo, Calif.
[DUAL MODE HYDRAZINE PROPULSION SYSTEM]
N. E. Morgan and W. W. Butcher 1 Aug. 1968 68 p Prepared for JPL
(Contracts NAS7-100; JPL-951720)
(NASA-CR-98634; Rept-68(22)-7830/B1183-002) Avail: CFSTI CSCL 21H

Work on a dual mode hydrazine propulsion system for attitude control and maneuvering of an advanced interplanetary space probe is reviewed. An experimental electrolysis module was constructed and performance measured over a variety of operating conditions.

The module was installed in a tank which allowed gas pulse venting in each of three attitudes as a demonstration of operating capability in +1 and −1 gravity. Test objectives were met and information obtained which will allow the design of an improved model. Author

N69-14210*# General Electric Co., Lynn, Mass. Aircraft Engine Group.
PERFORMANCE COMPARISONS OF HIGH MACH NUMBER COMPRESSOR ROTOR BLADING
J. P. Gostelow, K. W. Krabacher, and L. H. Smith, Jr. Washington NASA Dec. 1968 81 p refs
(Contract NAS3-7617)
(NASA-CR-1256) Avail: CFSTI CSCL 21E

Results of testing of four 1400 ft/sec tip speed single stage compressor rotors are presented. All rotors exceeded design efficiency and flow at conditions corresponding to design point operation. Operating range, from peak efficiency to stall, is highest in rotors designed for a low tip diffusion factor and which have the minimum amount of supersonic camber. Author

N69-14313*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF A 10° CONICAL TURBOJET PLUG NOZZLE WITH IRIS PRIMARY AND TRANSLATING SHROUD AT MACH NUMBERS FROM 0 TO 2.0
Donald L. Bresnahan Washington Dec. 1968 44 p refs
(NASA-TM-X-1709) Avail: CFSTI CSCL 21E

The efficiency of a full-length plug nozzle with a simulated iris primary throat remained above 96.5 percent at all flight conditions except subsonic cruise where external flow effects were significant. Nozzle efficiency was also sensitive to subsonic cruise pressure ratio, varying from 0.918 to 0.942 for pressure ratios from 3.25 to 4.0. Plug truncations to 30 percent of full length at supersonic cruise resulted in a 1 percent loss in efficiency. At subsonic cruise, the effects of truncation were greater, resulting in approximately 1/2 percent efficiency loss with a 65 percent plug and more than 3 percent loss with the 30 percent plug length. Author

N69-14384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID ROCKET ACOUSTIC-MODE-INSTABILITY STUDIES AT A NOMINAL THRUST OF 2000 POUNDS
E. William Conrad, Harry E. Bloomer, John P. Wanhainen, and David W. Vincent Washington Dec. 1968 95 p refs
(NASA-TN-D-4968) Avail: CFSTI CSCL 21H

Acoustic stability data for both hydrogen-oxygen and earth-storable propellant combinations were collected and correlated as far as possible. Several injector variables that presumably affect the oscillatory energy generation process provided significant stability improvements. Complete stabilization of hydrogen-oxygen rockets was achieved by proper selection of injection areas, element size, and oxidizer tube extension. Several injector variables influenced the stability of earth-storable propellants; however, dynamic stability was not achieved through injector modification. Energy absorbers were effective in suppressing acoustic-mode instability with both propellant combinations. Preliminary design guides for acoustic liners are also given. Author

N69-14386*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF HIGH-TURBINE INLET TEMPERATURE ENGINES IN A METHANE-FUELED SST WHEN TAKEOFF JET NOISE LIMITS ARE CONSIDERED
Robert W. Koenig and Gerald A. Kraft Washington Dec. 1968 60 p refs
(NASA-TN-D-4965) Avail: CFSTI CSCL 21E

Afterburning turbojet, nonafterburning turbojet, and duct-burning turbofan engine designs were optimized with respect to payload and direct operating cost for a Mach 3.0 cruise SST both with and without takeoff noise constraints. Only jet noise was considered, and none of the engines had noise suppressors. Design turbine-inlet temperature was varied from 2200° to 3100°F (1204° to 1704°C). Without noise restrictions, improvements occurred as the turbine-inlet temperature was raised. The duct-burning turbofan was best at low turbine temperatures, but the nonafterburning turbojet was superior at the upper temperatures. When jet exhaust noise restrictions are imposed, the duct-burning turbofan cycle was superior to the other cycles, with high-turbine-inlet temperature offering little benefit. High-turbine-inlet temperatures offer no benefits to turbojet cycles with noise restrictions. Author

N69-14496# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EARTHLY TASKS DONE BY A STELLAR SUBSTANCE
V. Afanas'yev 4 Dec. 1967 10 p Transl. into ENGLISH from Nauch-Teckhn. Obshch. SSR (USSR) no. 11, 1965 p 18–21
(AD-677251; FTD-HT-23-1101-67) Avail: CFSTI CSCL 20/9

The historical development of the plasma engine is discussed. Scientists are said to feel that techniques for developing a thermonuclear reaction in plasma are still in their infancy and that many problems have yet to be solved; however, sooner or later controlled thermonuclear reactions will provide man with an unlimited energy supply. The temperature of plasma can be changed; it has been proved theoretically that this temperature change can vary from one thousand to tens of thousands of degrees, and plasma power from one kw to millions of kw. The use of plasma in reaction engines was initiated in 1964 in the Soviet Zond-2 spacecraft. Terrestrial plasma has opened promising prospects in the conquest of outer space, and, according to Academician V. Kirillin, the Soviet Union will be able to start building industrial magnetohydrodynamic stations by 1970. TAB

N69-14600# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
THE GRUMMAN JET ENGINE RADIANCE PROGRAM
E. Stokes Fishburne Nov. 1968 34 p refs
(RM-432) Avail: Issuing Activity

A computer program has been devised that, given the engine conditions and plume flow field, predicts the infrared signature of a jet engine. It is based on a program originally developed by NASA for the theoretical computation of base plate heating on the Saturn launch missile due to radiation from the hot exhaust gas. The basic program has been substantially modified to include radiation from engine hot parts, atmospheric absorption, and a more detailed plume structure. Information obtained from this program has been employed for the prediction of the IR signature of the Grumman-proposed VFX. Other uses involve the evaluation of various IR suppression systems, determination of the lock-on range of missiles, and evaluation of the over-all IR signatures of jet aircraft. Author

N69-14772*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESEARCH AND DEVELOPMENT IN NEEDLE AND SLIT COLLOID THRUSTERS
Kenneth W. Stark and Allan Sherman Nov. 1968 49 p refs
(NASA-TM-X-63426; X-734-68-460) Avail: CFSTI CSCL 21C

A thorough familiarization and test program was conducted in capillary needle colloid thruster technology. This technology is basically a means by which electrostatic particle spraying can be

achieved through the use of slightly conductive propellants and high voltages. Forty-eight single needle tests were run with various needle materials and geometries using several propellant combinations. Several test facility variations were employed to study secondary electron effects. During this time two slit sources were designed and built. After the single needle testing was terminated the annular slit thruster was tested successfully. Future efforts will concentrate on continued testing of the annular slit thruster to perfect its overall performance. Author

N69-14774*# Bendix Corp., Davenport, Iowa. Instruments and Life Support Div.
DEVELOPMENT OF AN SPS/DPS HYDROGEN SHROUDED CRYOGENIC HELIUM STORAGE SYSTEM Final Report, Jul. 1967–Sep. 1968
William B. Bald 9 Oct. 1968 135 p refs
(Contract NAS9-7337)
(NASA-CR-92441; Publ.-4019-68; SO-33-12939) Avail: CFSTI CSCL 21H

The feasibility of using the concept whereby a primary cryogenic fluid is surrounded by a secondary refrigerant fluid was demonstrated earlier. The development of an SPS/DPS hydrogen shrouded cryogenic helium storage system is described which is sized to the approximate lunar module descent propulsion system requirements. Extensive testing performed on the completed system demonstrated its ability to meet the anticipated LM mission profile requirements. Methods for considerably extending the standby capabilities of a shrouded dewar are discussed. Author

N69-14814*# TRW Systems Group, Houston, Tex. Performance Analysis Section.
PROPULSION SYSTEMS DISPERSION ANALYSIS AND OPTIMUM PROPELLANT MANAGEMENT
R. K. M. Seto 28 Oct. 1968 32 p refs
(Contract NAS9-8166)
(NASA-CR-92458; TRW-11176-H060-R0-00) Avail: CFSTI CSCL 21H

The performance of a propulsion system during a given mission is a statistical variable, i.e., a function of quantities which exhibit varying degrees of uncertainty, such as helium regulator outlet pressures, propellant temperatures, and spacecraft weights. If the statistical variations of these variables are known, the performance variation can be determined. The report presents a procedure to develop dispersions for performance parameters. The approach is general to permit application to all primary Apollo propulsion subsystems and for solving problems in the variation of independent propulsion parameters. Also presented is a method of optimum propellant management. The focus is on determining the dispersions in the independent variables. Although it is stated that the independent variable dispersions are input to a Monte Carlo technique, the results are not restricted to the Monte Carlo method; they are equally applicable to such other methods as, for example, "root sum square". K.W.

N69-14857# Société Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France). Div. des Engins et de l'Espace.
AMMONIA RESISTOJET ENGINES [LE RESISTOJET A AMMONIAC]
René Morin and Christian Marion 1968 25 p In FRENCH
Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 28–31 May 1968
Avail: CFSTI

Physiochemical properties of ammonia are recalled and the decomposition ratio is plotted against temperature and pressure. A theoretical description of two types of resistojet is given and their performances indicated. Application to station keeping of 24-hour satellites is envisaged. ESRO

N69-14909*# Hughes Research Labs., Malibu, Calif.
HIGH-TEMPERATURE LM CATHODE ION THRUSTERS Quarterly Progress Report, 5 Aug.–4 Nov. 1968
J. Hyman, Jr. and J. R. Beyless 15 Nov. 1968 55 p refs
Prepared for JPL
(Contract NAS7-100; JPL-952131)
(NASA-CR-98720; QPR-3) Avail: CFSTI CSCL 21C

Reliable operation of the 30-cm thruster was demonstrated at a beam voltage V_B =2 kV. The 20-cm thruster exhibits total losses V_S =280 eV/ion at a mass utilization η_m =80% with a beam current I_B =480 mA at a beam voltage V_B =2 kV ($I_{sp,eff}$ =3,880 sec). At a beam voltage 3 kV ($I_{sp,eff}$ =4,400 sec at η_m =80%) the neutral flow-rate equivalent was throttled from 750 mA to 370 mA. To maintain η_m =80% this throttling required an increase in V_S by 70 eV/ion over the minimum of V_S =230 eV/ion obtained at I_B =600 mA. The liquid-fed LM cathodes K-25-V (annular) and K-45 (linear-slit), as well as the vapor-fed annular LM cathode K-26-III, all exhibit similar thermal characteristics in high-temperature (200°C–300°C) diode discharges operated in the range of interest for thruster operation. Measurements of Poiseuille flow of mercury through single-capillary flow impedances are linear and repeatable (5% standard deviation) over the range of flow-rate equivalent from 50 mA to 6.5 A. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N69-14175# Minnesota Univ., Minneapolis. Cosmic Ray Group.
THE VERY HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION. PART 2: INTERPRETATION OF THE ENERGY SPECTRA
C. J. Waddington and P. S. Freier 1968 38 p refs
(Contract Nonr-710(60))
(AD-677283; CR-116-Pt-2) Avail: CFSTI CSCL 4/1

An attempt has been made to understand the form of the observed energy spectrum of the highly charged, 20 less than Z less than 30, nuclei in the primary cosmic radiation. It is shown that the behavior of this spectrum relative to that of the helium nuclei also present in the cosmic radiation can be explained by assuming that the highly charged nuclei have two components. The first of these components is dominant at high energies and has a spectrum at the source that can be represented as a simple power law with a slope somewhat flatter than that of the source spectrum of the helium nuclei. The nuclei in this component may be regarded as having traversed several g/sq cm of matter between the times of acceleration and of detection. The second component is only of importance at relatively low energies, of a few hundred MeV per nucleon, has a spectrum that falls steeply with increasing energy and cannot simply be represented as a power law. The possible consequences of such a model are briefly considered. Author (TAB)

N69-14176# Minnesota Univ., Minneapolis. Cosmic Ray Group.
THE VERY HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION. PART 1: OBSERVATIONS ON THE ENERGY SPECTRUM
P. S. Freier and C. J. Waddington 1968 33 p refs
(Contract Nonr-710(60))
(AD-677282; CR-115-Pt-1) Avail: CFSTI CSCL 4/1

The intensities and energy spectrum of the medium and, very heavy, MH- and VH-nuclei, 16 less than Z less than 30, present in the primary cosmic radiation have been studied using

three stacks of nuclear emulsions exposed on high altitude balloons flown over Fort Churchill, Texas and India. Integral intensities of Z greater than 20 nuclei above energies of 0.225, 1.58 and 7.1 BeV per nucleon were respectively 1.50 plus or minus 0.06, 0.403 plus or minus 0.023 and 0.090 plus or minus 0.006 VH-nuclei/sq m ster.sec. In addition the shape of the energy spectrum of these nuclei was observed in detail for 0.225 less than T less than 1.0 BeV per nucleon. The intensities and energy spectra of those nuclei with 16 less than Z less than 19 were also studied although with less statistical accuracy. Among approximately 1600 VH-nuclei observed in this study there were none with Z greater than 32.
Author (TAB)

N69-14232# Lincoln Lab., Mass. Inst. of Tech., Lexington.
CHARGED PARTICLE RADIATION ENVIRONMENT IN SYNCHRONOUS ORBIT
Alan G. Stanley and Jean L. Ryan 15 May 1968 53 p refs
(Contract AF 19(628)-5167)
(AD-677284; ESD-TR-68-12; TR-443) Avail: CFSTI CSCL 22/2

The present state of knowledge of the charged particle radiation environment in synchronous orbit is described. The composition, intensity, energy spectrum and temporal variations of the radiation are listed. The data are based on measurements on board satellites in elliptical and in synchronous orbits, including the results from the electron telescope on board LES-4, whose apogee is in synchronous orbit. The radiation consists mainly of trapped electrons and low energy protons, but solar flare protons also make a significant contribution. The time-averaged data are given in a form useful for predicting the long-term radiation environment to which a satellite in synchronous orbit would be exposed. Author (TAB)

N69-14974*# Volt Information Sciences, Inc., Washington, D. C.
DIMENSIONS OF THE MAGNETOSPHERE TAIL'S CROSS SECTION AT VARIOUS INTENSITIES OF POLAR DISTURBANCES
A. D. Shevnin and Ya. I. Fel'dshteyn 2 Jan. 1969 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 870–876
(Contract NAS5-12487)
(NASA-CR-98703; ST-PF-GM-10792) Avail: CFSTI CSCL 04A

The equatorial semiaxis of the elliptically shaped magnetosphere tail is computed at the distances from 10 to 80 Earth radii on the basis of magnetic field measurements on IMP-1 and Explorer-33. It is shown that, as polar disturbances increase, the process of tail contraction by solar wind prevails over the expansion due to the increase of magnetic flux in the tail, as the southern boundary of the oval shifts toward the equator. Author

N69-15003*# Volt Information Sciences, Inc., Washington, D. C.
COSMIC RAYS AND DYNAMICS OF THE SOLAR WIND, 2
I. V. Dorman et al Greenbelt, Md. NASA. Goddard Space Flight Center 27 Dec. 1968 11 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 6, 1968 p 1008–1013
(Contract NAS5-12487)
(NASA-CR-98727; ST-CR-IGA-10789) Avail: CFSTI CSCL 20H

It is shown that the region of the solution of the nonlinear differential equation of 2nd order, describing the interaction of galactic cosmic rays with the solar wind is broken down into four regions. In the first two regions (nearest to the Sun), just as also in the latter (closest to the turbulent layer) an approximate analytical solution is obtained. A numerical solution is found for the third region. The wind velocity variation with recession from the Sun is determined, just as is the distance to the turbulent layer in solar activity maximum and minimum. Author

N69-15006*# Volt Information Sciences, Inc., Washington, D. C.
COSMIC RAYS AND DYNAMICS OF THE SOLAR WIND, 1
I. V. Dorman et al Greenbelt, Md. NASA. Goddard Space Flight Center 10 Dec. 1968 10 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 5, 1968 p 817–821
(Contract NAS5-12487)
(NASA-CR-98730; ST-CR-NP-10784) Avail: CFSTI CSCL 20H

When investigating the propagation of cosmic rays in interplanetary space, solar wind is considered as given and independent of cosmic rays. It is shown that, considering rigorously the problem, one must take into account the inverse action of cosmic rays on the fluxes of solar plasma, which is materialized by way of magnetic fields. The integral-differential equation is derived, which describes the interaction of solar wind with cosmic rays, taking into account the intensity modulation and the deceleration of solar wind by cosmic rays. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N69-13957 Northwestern Univ., Evanston, Ill.
RADIATIVE TRANSFER IN FINITE EXTENDED STELLER ATMOSPHERES
William Patrick Pearce (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-3210

This investigation is devoted to finding an approximate solution to the radiative transfer equation in a finite, grey, spherically symmetric, isotropic, purely scattering atmosphere in radiative equilibrium. The curvature of the atmospheric layers is explicitly taken into account, with the objective of obtaining results which may be applied to the case of an atmosphere which is extended in the sense that the intensity scale height at a point in the atmosphere is not negligible relative to the local radius of curvature. The discrete ordinate method is employed and the solution is carried through the second approximation. The use of this approximation method is patterned after the approach employed by Chandrasekhar in treating the simpler case of an infinite atmosphere.
Dissert. Abstr.

N69-13987*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRAJECTORY CONSIDERATIONS FOR A MISSION TO JUPITER IN 1972
R. A. Wallace 15 Mar. 1968 71 p refs
(Contract NAS7-100)
(NASA-CR-98592; JPL-TM-33-375) Avail: CFSTI CSCL 22C

The results of a preliminary study of trajectory considerations for a mission to Jupiter in 1972 are presented. Minimum launch energies for the 1970–1980 decade are shown to place the 1972 opportunity in perspective. A short discussion of Jupiter is given to show how the trajectory analysis could be affected by the unique properties of the planet. Trajectory design charts are given for the 1972 launch opportunity in the form of launch and arrival data plots with pertinent trajectory parameter overlays. Using these design charts, a launch period and interplanetary trajectories were selected. Also included are the trajectory considerations for an orbiter of Jupiter and an appendix tabulating the geocentric, heliocentric, and zeocentric (i.e., a coordinate system centered at Jupiter) conditions of the selected trajectories. Author

N69-13989 Princeton Univ., N. J.
THERMAL GENERATION OF HYDROMAGNETIC WAVES IN SUNSPOTS
Blair DeWillis Savage (Ph.D. Thesis) 1967 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilms $3.00 Order No. 68-2514

Calculations on the hydromagnetic stability of a thermally unstable layer traversed by a vertical magnetic field with open boundary conditions have been extended to include the effects of hydromagnetic wave reflection due to a rapidly decreasing density with height above the layer. The wave reflection is studied by determining the effect of standing surface gravity waves arising from a density discontinuity at the boundary of a superadiabatic layer and an adiabatic region above. For parameters characteristic of solar magnetic regions, the presence of gravity waves tends to close the boundaries and therefore reduces the threshold for emission of hydromagnetic waves by overstable oscillations in the layer. The calculations predict that overstable oscillations and hence thermal hydromagnetic wave generation will occur in sunspots with vertical magnetic field strengths less than approximately 4000 gauss. For larger field strengths no unstable modes are found. Dissert. Abstr.

N69-13995# General Precision, Inc., Tarrytown, N. Y.
THE APPLICATION OF DYNAMIC PROGRAMMING TO LOW THRUST INTERPLANETARY ORBIT TRANSFERS
F. T. Smith and C. T. Leondes (Calif. Univ., Los Angeles) [1967] 38 p refs
Avail: Issuing Activity

The orbit transfer problems considered involved the modification of the motion of a space vehicle moving in a conservative force field. This motion is to be changed from that defined by some known initial trajectory to that defined by some desired terminal trajectory in accordance with some specified performance criteria. Since all orbit transfers involve the motion of a vehicle, some means of precisely describing this motion is necessary. This requires the derivation of the differential equations of motion for the vehicle with respect to a suitable coordinate system. The motion of the vehicle can then be represented by the time behavior of the variables forming the set of solutions to the differential equations. The choice of a suitable coordinate system depends upon the particular circumstances under which the motion takes place. Usually, the motion of the space vehicle must satisfy a set of performance requirements as well as the equations of motion. These performance requirements can be represented mathematically by a functional. The functional often consists of a measure of the terminal errors in the variables describing the vehicle's motion and a measure of the energy used during the orbit transfer. Author

N69-13998*# Bureau of Mines, Minneapolis, Minn.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Annual Status Report for Period Ending 1 Jul. 1968
1968 65 p refs
(Contract NASA Order R-09-040-001)
(NASA-CR-98633) Avail: CFSTI CSCL 22A

Summary data are presented on the annual progress of 14 research projects being conducted to develop mineral resource technology for supporting manned lunar and planetary missions. The information reported covers surface, thermophysical, strength, and elastic properties of rock in lunar environment; use of explosives in drilling on the moon; thermal fragmentation studies; electrowinning of oxygen from silicate rocks; magnetic and electrostatic properties of minerals in a vacuum; stability of hydrous silicates and oxides in lunar environment; reduction of silicates with carbon; support for underground lunar shelter; and effect of lunar environment on the behavior of fine particles. B.P.

N69-14020 Cornell Univ., Ithaca, N. Y.
TERRESTRIAL MODIFICATION OF TRACE ELEMENTS IN IRON METEORITES
Edgar Berkey (Ph.D. Thesis) 1967 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-3497

Neutron activation analysis, spark source mass spectrometry, and metallography were used to investigate possible changes in iron meteorite trace element composition produced by terrestrial residence. Such information is important for iron meteorites because about 90% of all known specimens are *finds*, having unknown, and possibly quite lengthy, terrestrial residence ages. In general, it has been experimentally established for the first time that terrestrially induced processes can profoundly affect the trace composition, adding large amounts of some elements to the matrix, while at the same time removing others from it. A study of the chlorine content of iron meteorites by activation analysis revealed that the element can be enhanced in *finds* by many orders of magnitude over certain localized regions. Smithonia iron meteorite was studied by spark source mass spectrometry to obtain simultaneous information on the distribution of a large number of elements. The elements O, S, Cl, Br, I, and P were found to be significantly enhanced in the meteorite near the surface. The elements Na, K, and Ca gave indications of being depleted in the same regions. Dissert. Abstr.

N69-14106 Maryland Univ., College Park.
DIFFUSION OF HEAVY IONS IN THE SOLAR CORONA
Yves Jean Alloucherie (Ph.D. Thesis) 1967 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-3333

The steady-state diffusive motion of ionized atoms in the solar corona has been investigated theoretically, with special emphasis on relating the flow velocity and density of these ions to the flow properties of the ionized hydrogen background, under the assumption that the sun and its environment exhibits total spherical symmetry. The basic approach taken in this study was to regard the ions as "test particles" immersed in, and interacting with, the electrons and protons making up the bulk of the corona. Two forms of the momentum equation were first derived for the ions. It was found that the ions considered in the sample diffuse away from the sun with velocities somewhat lower than the velocity of the hydrogen background; the relative abundance of the ions, after a slight decrease near the bottom of the corona, increases gradually and slowly with height. Dissert. Abstr.

N69-14158# American Broadcasting Co., New York.
SPACE COVERAGE—PERILS, PROBLEMS, AND THE PAYOFF
Jules Bergman *In* NASA, Manned Spacecraft Center Space Sci. Writing at a Down to Earth Level Jan. 1968 p 3-13 (See N69-14157 04-08)
Avail: CFSTI

The sociological problems facing our nation are discussed in relation to the tremendous breakthroughs that science is making. Stress is placed on medical progress and the need for more hospitals and more trained medical technicians and doctors, on oceanographic exploration to feed the peoples of the world, on safety in all types of transportation. The tremendous strides in technological and scientific knowledge generated by the space program is stressed. Serious consideration is given to the need for closer interaction between the engineer, the scientist, and the writer in order to accept and communicate the challenges facing the world today. M.G.J.

N69-14168*# California Univ., Berkeley. Space Sciences Lab.
SOLAR RADIATION AND ATMOSPHERIC ABSORPTION IN THE mm WAVE REGION Semiannual Report, 1 Apr.-30 Sep. 1968

Samuel Silver and William J. Welch 30 Sep. 1968 3 p *Its* Ser. 9, Issue No. 51
(Grant NsG 243; Contract Nonr-222(54); NSF GA-527)
(NASA-CR-98607; AD-675267) Avail: CFSTI CSCL 03B

An outline of accomplishments in the program (1) to study absorption and emission of millimeter waves, and (2) to develop radiometric techniques at millimeter wave length is presented. Some of the calibration of the 20-foot antenna has been completed and routine observations have been initiated. By star tracking studies, correction charts are being prepared for pointing. Antenna gain has been measured accurately at 4 frequencies, and aperture efficiency is expected to be about 50% at 90 GHz. The computer programs for PDP-8/S computer have been completed. F.O.S.

N69-14174# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astro Physics Lab.
LAVA FLOWS IN MARE IMBRIUM
G. Fielder and J. Fielder Aug. 1968 43 p refs
(AD-677567; D1-82-0749) Avail: Issuing Activity CSCL 3/2

A 130 km long flow in Mare Imbrium is described. It is argued that the flow is of basalt from a fissure eruption. The number density of craters smaller than about 200 m in diameter is essentially equal on and off the flow, but there are approximately twice as many craters larger than 200 m on the flow as there are in the adjacent, older unit. It is reasoned that the excess of craters on the flow is not due to secondary impact and that at least 50% of the larger craters on the flow are of endogenic origin. Of the endogenic craters, the majority have been produced basically by collapse, although other types of crater are also present. Author (TAB)

N69-14274*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
PHOTOGRAPHIC NETWORKS FOR FIREBALLS
Richard E. McCrosky and Zdenek Ceplecha 4 Oct. 1968 25 p refs
(Grant NsG-291-62)
(NASA-CR-98658; SAO Special Rept.-288) Avail: CFSTI CSCL 03A

The combined results of two photographic networks designed to observe bright meteors (the Prairie Network in the U.S.A. and the All-Sky Network in Czechoslovakia and West Germany) are compared with the expectation for these operations. We find that the mass flux of fireballs into the earth's atmosphere is greater than anticipated, while the influx of meteorites is apparently less than expected. As a provisional resolution of this anomaly, we suggest that most of the objects observed are low-density fragile meteoroids that undergo nearly complete ablation. A reanalysis of the Pribram meteor data has been made, and on this basis we suggest that gross fragmentation of stony meteorites in the high atmosphere may be a common phenomenon. Author

N69-14309 Wisconsin Univ., Madison.
THE SPATIOKINEMATIC STRUCTURE OF PLANETARY NEBULAE
Daniel Wilson Weedman (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17048

Models based on an analysis of the line profiles derived from high dispersion spectrograms of bright emission lines in the planetaries are presented. The models include descriptions of the shell shapes, degrees of homogeneity, and the matter distribution through the shells. The kinematic features describe the expansion velocities of different parts of the shells. It was found that ellipsoidal shells show a velocity of expansion which increases with distance from the central star, implying that the shell is now ellipsoidal because the original velocity of ejection varied with direction. The radii at different parts of a shell do not appear to be directly proportional to the expansion velocities, however, and this fact is used together with an apparent relation between a shell's thickness and its expansion velocity to infer that a long term pressure acted to eject the shell. Of particular interest was NGC 7662. A detailed model shows the inner emitting shell to be quite thin, the thickness being about one-fifth of the radius. The gradient of expansion velocity through this shell is accurately determined, and its magnitude indicates that the observed line profiles can be explained without assuming the existence of turbulent motions within the shell. Dissert. Abstr.

N69-14317 Cornell Univ., Ithaca, N. Y.
SPATIAL AND TEMPORAL RESOLUTION OF MULTUOULE EXTENSIVE AIR SHOWERS BY MEANS OF ATMOSPHERIC FLUORESCENCE
Peter Bruce Landecker (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-6596

An experiment to extend the cosmic ray spectrum, record the incident direction and energy of rare primary cosmic rays in the energy range from 10^{17} to 10^{21} eV, and to extract the astrophysical and cosmological implications associated with the data is described. The detector system when completed consists of a mosaic of 505 two-inch diameter photomultiplier tubes clustered in the focal surfaces of 16 large fresnel lenses and is housed in a 16-sided semi regular convex polyhedron structure. To image the entire sky, each phototube looks at a different 0.01 str sector of the sky. The recording system is activated when there is a pulse above threshold in one channel and a delayed pulse in an adjacent channel following within a time slightly greater than the width of the first pulse. The electronics and hardware used in a pilot version of this experiment are discussed in detail. Relevant spectral characteristics, expected signal and noise levels, and the expected counting rates are discussed. An artificially produced simulated inverse air shower is analyzed after being recorded by a pilot detector system consisting of a cluster of 37 photomultipliers. Dissert. Abstr.

N69-14392*# Michigan Univ., Ann Arbor. Radio Astronomy Observatory.
INSTRUMENTATION FOR RADIO ASTRONOMY MEASUREMENTS ABOARD THE OGO-5 SPACECRAFT
B. D. MacRae 20 Sep. 1968 142 p refs
(Contract NAS5-9099)
(NASA-CR-98670) Avail: CFSTI CSCL 22A

This report describes the design considerations and performance characteristics of a satellite-borne instrumentation system designed and constructed at the University of Michigan Radio Astronomy Observatory. The system is designed to make radio astronomy measurements at eight discrete frequencies from 50 kHz to 3.5 MHz. These measurements are to detect Solar and Jovian radio frequency bursts and to determine the relative average level of cosmic background radiation down to 50 kHz. Procedures used for preflight and in-flight noise calibrations are discussed. A description of the ground support equipment used for preflight testing is given. The instrument was successfully launched aboard the OGO-V(E) spacecraft on 4 March 1968 into an elliptical orbit having the following approximate parameters: perigee, 292 kilometers; apogee, 147,000 kilometers; inclination to the equator, 31°; period, 63 hours, 25 minutes. The initial data from the instrument looks excellent and the instrument should successfully fulfill its missions. The scientific aspects and results of this program will be published separately. Author

N69-14393*# Michigan Univ., Ann Arbor. Radio Astronomy Observatory.
DATA REDUCTION AND ANALYSIS REPORT FOR THE RADIO ASTRONOMY EXPERIMENT ABOARD THE OGO-2 SPACECRAFT

Aug. 1968 24 p refs
(Contract NAS5-3099)
(NASA-CR-98669; Rept-68-12) Avail: CFSTI CSCL 22A

The Radio Astronomy Observatory of the University of Michigan has identical experiments on the OGO-II and OGO-IV spacecraft, whose primary objective is to generate a map of the cosmic noise background at a frequency of 2.5 MHz, using ionospheric focussing to provide resolution. Because of various spacecraft problems, it does not appear that the OGO-II experiment will achieve this objective. Therefore, the data from this experiment has not been fully processed. It is possible, however, that OGO-II data may be of some value to supplement that obtained from OGO-IV, or may yield valuable information on the earth's ionosphere. Author

N69-14428*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A COMPUTER PROGRAM FOR CALCULATING EXTERNAL THERMAL-RADIATION HEAT LOADS AND TEMPERATURES OF SPACECRAFT ORBITING THE PLANETS OR THE MOON
Harold L. Finch (Midwest Res. Inst.), Duncan Sommerville (Midwest Res. Inst.), Robert Vogt, and Davis Bland Washington Dec. 1968 195 p refs
(NASA-TR-R-278) Avail: CFSTI CSCL 22A

A versatile computer program to predict the thermal history of a spacecraft orbiting a celestial body is documented. With this program, all external thermal-radiation heat loads, thin-skin temperatures, or both, are computed for a spinning or oriented spacecraft as a function of orbit position and time. The generalized program applies to any spacecraft configuration. A major feature of the program is its applicability to effects resulting from the extreme surface temperature of the Moon. Author

N69-14436# Tubingen Univ. (West Germany).
THE ZONEPLATE [DIE ZONENPLATTE]
J. V. Feitzinger Sep. 1968 172 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-63) Avail: CFSTI

The use of the zoneplate as an image system in X-ray optics, especially for solar X-ray astronomy is studied. All available material on the zoneplate is reviewed. General formulas are presented in the framework of Kirchhoff's diffraction theory of the intensity distributions produced by a X-ray point source which is imaged by a zoneplate. They are applied for the case of a micro-zoneplate (r_1 =0.021 mm, N =38) and for the wavelengths 34, 40, 50, 55 A. The overlapping of intensity distributions on the optical axis and in a focal plane is discussed for these wavelengths. Author

N69-14437# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-Sous-Bagneux.
OPTIMAL TRANSFER BETWEEN CLOSE ELLIPTICAL ORBITS [TRANSFERTS OPTIMAUX ENTRE ORBITES ELLIPTIQUES PROCHES]
Jean-Pierre Marec 1967 261 p refs In FRENCH; ENGLISH summary
(PUBL-121) Avail: CFSTI

The optimal rendezvous and transfers between close elliptical orbits are analyzed in the case of propulsion systems characterized by a constant ejection velocity and a limited thrust; the performance obtained is compared to the performance of propulsion systems characterized by a modulable thrust and a limited power. The choice of the orbital elements as state components, added to the linearization hypothesis, leads to important simplifications (the adjoint vector is constant, in particular). This gives some general results concerning the number of maximum thrust arcs per revolution, the singular cases when the linearized solution is not unique but degenerates into a large number of solutions, and the nonimposed variations of the other orbital elements. The solution brings in the notions of efficiency vector indicating the direction of the optimal thrust, of directrix orbit (locus in the absolute axes reference system of the efficiency vector extremity originating at the mobile) and of efficiency curve (locus of this extremity in the rotating axis system). The analytical solution is developed for optimal transfers: of infinitely small variation of the semi-major axis; of infinitely small rotation of the orbital plane; of close coplanar circular orbits; of the Hohmann type between non-intersecting direct, coaxial, close near circular orbits; and optimal long duration rendezvous between coplanar or non coplanar, close near circular orbits. Author

N69-14479*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPLICATION OF HANSEN'S METHOD TO THE XIth SATELLITE OF JUPITER
Peter Musen, Jesse L. Maury, and Milton Charnow (Computer Sci. Corp.) Washington Dec. 1968 26 p refs
(NASA-TN-D-4979) Avail: CFSTI CSCL 03C

New orbital elements and the table of the general perturbations of the X^{th} satellite of Jupiter are presented. A modification of Hansen's theory was the theoretical foundation for the programming and for the expansion of Hansen's coordinates of the satellite into trigonometric series in four basic arguments. The complete collection of formulas is given, and the program and operations for handling the expansions and for integrating the differential equations of the theory by means of iteration are described. The new set of elements represents the observations in the interval 1938–1967 better than the previous sets. The residuals are now of the order of only a few seconds of arc. Author

N69-14524 Ohio State Univ., Columbus.
A SPECTROSCOPIC AND PHOTOMETRIC INVESTIGATION OF THE STELLAR ASSOCIATION CEPHEUS OB2
Simon Christian Simonson, III (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-3067

Cepheus OB2 was investigated with spectral classification and photometry. Sixty-two stars of types O and B were classified on the MK system using spectrograms at 80/mm taken with the 72-inch telescope. Photoelectric UBV observations of these stars and 20 fainter stars were made with the 21-inch telescope at the Lowell Observatory. Objective prism spectra at 1000 Å/mm were taken over an area of 100 square degrees covering the association, and stars of type O and B were classified to a limiting magnitude B = 11.5. The V magnitudes and B–V colors of these stars were measured on plates taken with a 4-inch Ross camera. The results show that the stars assigned to the association are distributed across the spiral arm from 300 pc to 1400 pc. However, between 750 pc and 1050 pc a group of stars is found that has most of the characteristics of OB associations in the solar neighborhood. Dissert. Abstr.

N69-14528 Indiana Univ., Bloomington.
A KINEMATIC STUDY OF FAINT A STARS
Arthur Young (Ph.D. Thesis) 1967 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-2379

Radial velocities have been determined for 333 stars of spectral class B8 to A2, and apparent visual magnitudes between +10 and +11.5. Photoelectric UBV photometry of 50 of these stars indicates that they are strongly reddened, with a mean distance of 600 parsecs. The effect of galactic rotation on the radial velocities of these stars is too small to be detected with certainty owing to the large cosmic dispersion in both velocity and distance, and to the large measurement error. The cosmic dispersion in velocity is larger than normal for A stars (Σ_u = 21 km/sec, Σ_v = 18 km/sec), and indicates a nearly spheroidal distribution. A streaming

effect similar in magnitude and direction ot the Ursa Major (Sirius) Group is observed among the faint A stars, but not among the bright ones. The existence of a local "group" not partaking in the general "streaming" is suggested. Dissert. Abstr.

N69-14530*# Smithsonian Institution, Washington, D. C.
A STUDY OF THE ECLIPSING BINARY BETA AURIGAE
Larry G. S. Toy Dec. 1968 18 p refs
(Grant NGR-22-024-001)
(NASA-CR-98602; REPT-809-201) Avail: CFSTI CSCL 03B

The present study has led to the determination of the average effective temperature and surface gravity of the two components of the eclipsing binary system β Aur. By use of photoelectric spectrum scans fitted to Mihalas's (1966) line-blanketed model atmospheres in conjunction with detailed abundance analyses, an effective temperature, T_{eff} = 8750°K, and surface gravity, log g = 3.7, were derived. The abundance analyses indicate similar chemical compositions for both components. Both members of this system appear to show abundance anomalies reminiscent of mild Am stars. Author

N69-14548 California Univ., Davis.
A NUMERICAL INVESTIGATION OF THE ENERGY BALANCE OF THE PLANET MARS
Monty Dale Coffin (Ph.D. Thesis) 1967 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-6020

An effort is made to simulate the gross features of the energy balance of the Martian planet. A six-level atmospheric model is used. Energy transfer processes in the atmosphere are coupled to heat conduction and energy storage in the planet surface layers. A two-dimensional model is used so that calculations can be accomplished throughout annual orbital periods. Simplified methods, appropriate to the Martian atmosphere, are developed for treating solar radiation absorption, longwave radiation transport and vertical convective transport. The use of CO_2 as the only active volatile in the Martian atmosphere gives results which appear to be consistent with observations. In particular, the formation and dissipation of the polar caps is in good agreement with observations. The surface energy balance is found to be relatively independent of atmospheric effects including the horizontal transport of energy. There are indications that CO_2 in the upper atmospheric levels is in a saturated equilibrium state. Dissert. Abstr.

N69-14548 Wisconsin Univ., Madison.
AN INVESTIGATION OF THE DELTA SCUTI STARS
Robert Lowell Millis (Ph.D. Thesis) 1968 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-5336

The results of a search for short-period variability among the brighter late A and early F giants and subgiants are presented. Of the fifty-nine field stars observed, at least fifteen percent are short-period variables. The new discoveries show that this type of behavior occurs in stars covering a larger range in spectral type, color, amplitude, period, and rotational velocity than was originally believed. The blue boundary of the Delta Scuti zone has been extended almost to the main sequence. Evidence is given for the existence of a sharp boundary on the red side of the zone at B−V = + 0.35 mag. Periods as short as 50 min, amplitudes as small as 0.015 mag, and values of v sin i as large as 150 km/sec are found to occur in these stars. A few nonvariable stars have been found which definitely fall among the variables in the color-magnitude diagram. These stars are all rapid rotators. Dissert. Abstr.

N69-14568# McGill Univ., Montreal (Quebec). Space Research Inst.
SIMPLIFIED FORMS OF PRELIMINARY TRAJECTORY CALCULATION FOR GUN-LAUNCHED VEHICLES
G. V. Parkinson Aug. 1967 78 p refs
(Contract DA-18-001-AMC-746(X))
(AD-677416; SRI-R-19) Avail: CFSTI CSCL 19/4

An approximate numerical method for calculation of trajectories of hypersonic vehicles is described, with particular reference to gun-launched vehicles. Because of the form of the hypersonic drag coefficient, a relatively simple calculation using functions which depend only on altitude is possible. Reasonable accuracy can be obtained even for computations in which very large calculation intervals are used. The method is particularly suitable for preliminary engineering calculations which do not justify a detailed computer solution, and has the added advantage of giving the analytic forms linking input and output. The technique is shown to be applicable to glide trajectories with and without drag and to rocket powered trajectories as well. Author (TAB)

N69-14570# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE PRECESSION AND NUTATION OF DEFORMABLE BODIES. 6: EQUATIONS OF MOTION AND THEIR SOLUTION
Zdenek Kopal Aug. 1968 55 p refs *Its* Math. Note 572
(AD-677108; D1-82-0753) Avail: Issuing Activity CSCL 3/3

The Eulerian equations for the precession and nutation of fluid bodies undergoing spheroidal deformation, deduced in the preceding report of this series are now particularized to the form in which they can be solved as ordinary differential equations for the time-dependent Eulerian angles theta, phi as well as for the angular velocity omega sub z of axial rotation, with account being taken of variable deformation produced by dynamical tides. Author (TAB)

N69-14573# Harvard Coll. Observatory, Cambridge, Mass.
RESEARCH IN MEASUREMENT OF RATIOS OF POLARIZATION TO ABSORPTION FOR STARS ALONG THE MILKY WAY Final Report, 1 May 1963–31 Mar. 1968
William Liller Sep. 1968 14 p refs
(Contract AF 19(628)-2790)
(AD-677001; AFCRL-68-0484) Avail: CFSTI CSCL 3/2

Following a study of existing stellar polarimeters, there emerged the optical, mechanical and electronic design of an eight color, two channel, d.c. integrating polarimeter to be used primarily at the Cassegrain focus of the 61-inch reflector at Harvard University's G. R. Agassiz Station. The instrument was assembled and tested at the Harvard College Observatory and has been in full operation for nearly one year. Its performance has proven excellent, and with a basic semi-automatic operation cycle of 13.5 minutes it can produce monochromatic polarization measures for stars brighter than ninth magnitude with a precision of about plus or minus 0.2 per cent. Observations have been made of (1) numerous stars along the Milky Way, (2) two galactic novae, (3) several planetary nebulae, (4) satellites of Jupiter and Saturn, (5) several asteroids, and (6) several miscellaneous stars of unusual interest. Most objects have been observed polarimetrically for the first time, and the results have either been reported or will soon be reported in the astronomical literature. Author (TAB)

N69-14596# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE EROSION ON THE LUNAR SURFACE
Zdenek Kopal Jul. 1968 46 p *Its* Math. Note 566
(AD-677419; D1-82-0734) Avail: Issuing Activity CSCL 3/2

High-resolution photographs of the lunar surface obtained by the U.S. Lunar Orbiter Satellites in 1966-1967 have revealed the concentration, in many regions, of boulders between 1-20 m. in size, with a fairly sharp frequency cutoff above this limit (due probably to finite rock strength). Such boulder fields are found, in particular, to abound on the tops of small domes (well evidenced, for instance, on the floor of the crater Copernicus), but occur also

in flatlands. This new evidence--combined with out present knowledge of the bearing strength of the lunar surface disclosed by the soft-landers--shows that such boulders could not have been deposited in their present exposed positions by any kind of impacts (including the secondary or tertiary ones); for any boulders impacting with a velocity of the order of 100 m/sec or greater would have penetrated under the surface to a depth equal to many times the actual dimensions of the impacts. It appears, therefore, almost inevitable that the boulders we see now (particularly in lunar flatlands) must have been gradually exhumed from their original underground locations by mechanical erosion processes (principally moonquakes triggered by primary impacts). Author (TAB)

N69-14630 Stanford Univ., Calif.
A TEST-PARTICLE ANALYSIS OF PLASMA TURBULENCE IN ASTROPHYSICS
Donald Eugene Hall (Ph.D. Thesis) 1967 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-6427

To investigate the origin of high-energy particles, an idealized problem was studied. Test particles are pictured in a general configuration of steady or slowly changing electromagnetic fields, to which an arbitrary spectrum of small random fluctuations is added to represent weak plasma turbulence. The behavior of the particles is found in terms resembling the quasi-linear theory of plasma disturbances, and advantages of this method over the previously used Fokker–Planck approach are described. The limits of applicability of the theory are stated and explained. The result takes the form of a generalized diffusion equation in the phase space; the diffusion coefficients are determined by past history integrals of the second order correlation functions of the fluctuations, evaluated for pairs of points lying on unperturbed orbits. The particular case considered in detail is that of relativistic particles moving in stochastic fields in an otherwise uniformly magnetized plasma. Dissert. Abstr.

N69-14667*# Volt Information Sciences, Inc., Washington, D. C.
FLIGHT TRAJECTORIES AROUND PLANETS WITH RETURN TO EARTH
V. R. E. Brauze, A. A. Da Hkov, and V. N. Kubasov 6 Jan. 1969 13 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 803–811
(Contract NAS5-12487)
(NASA-CR-98693; ST-ASD-CM-10793) Avail: CFSTI CSCL 22C

Methods for calculating close planetary flyby trajectories are discussed, taking into account planetary perturbations. Details of trajectories around Venus and Mars are given as a function of total flight time and flyby distance near the planet. It is shown that during flight to Venus in 1967, the departure velocities from Earth with return capability exceed only insignificantly the values of optimum velocities of flight without return. Trajectories similar to those considered in this paper exist not only for the Mars takeoff in 1969 or to Venus in 1967, but also in other years, with intervals between optimum takeoff dates to Mars about 2.14 years and to Venus about 1.6 years. Author

N69-14701 Arizona State Univ., Tempe.
THE CONCENTRATIONS AND DISTRIBUTIONS OF SELECTED CHEMICAL ELEMENTS IN THE METALLIC, SULFIDE, AND PHOSPHIDE PHASES OF IRON METEORITES VIA NEUTRON ACTIVATION ANALYSIS
Thomas Arthur Linn, Jr. (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-6801

The behavior of selected chemical elements in the iron meteorites has been investigated. A nondestructive method of activation analysis is applied to small samples of the metallic and major phases from iron meteorites. The concentrations of vanadium, manganese, cobalt, copper, and gold in the metal, sulfide, and phosphide phases of the iron meteorites are determined. Calculations are then made to obtain the distribution ratios between phases. The concentrations and distribution ratios are related to the structural classes, to nickel content, and to the Ga-Ge groupings of the meteorites studied. The concentration data provide more complete chemical characterization of these meteorites. The distribution ratios provide information about the geochemical behavior of these elements in the phases studied. Dissert. Abstr.

N69-14724 Yale Univ., New Haven, Conn.
DETERMINATION OF THE MASS OF JUPITER FROM THE MOTION OF 65 CYBELE
Douglas Alexander O'Handley (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-5193

The asteroid 65 Cybele is one of the 13 asteroids which has a mean motion nearly double that of Jupiter and exhibits a large inequality of a long period arising from the near resonance between Jupiter and Cybele. A total of 771 observations was collected from publications. These observations, having been reduced to the standard equinox of 1950.0, were compared to an orbit which was numerically integrated by Cowell's method. Of the total set, 542 observations were found to be of sufficient accuracy to be used in improving the elements of the orbit and 318 of these observations were placed on the stary system of FK 4. Having the definitive set of osculating elements, the residuals between the observations and the final orbit were analyzed for the amplitude of the principal perturbation in longitude which has the period of 94.49 years. A few selected values of the mass-ratio of the Sun to Jupiter were used in the calculation of additional orbits of Cybele. The value for the mass-ratio of the Sun to Jupiter which minimized the sum of the squares of the residuals in $\Delta\alpha \cos\delta$ is found to be 1/1047.380. Dissert. Abstr.

N69-14733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GODDARD SPACE FLIGHT CENTER COSMIC DUST EXPERIMENT PROPOSAL FOR PIONEER F AND G
Otto E. Berg and John A. O'Keefe Nov. 1968 26 p
(NASA-TM-X-63418; X-616-68-477) Avail: CFSTI CSCL 22A

The GSFC Cosmic Dust Experiment proposed for Pioneer F and G is an improved version of that experiment currently and successfully performing in Pioneers 8 and 9, and to be launched in Pioneer E. It is a complex of plasma sensors, acoustical sensors, sensor controls, and monitor electronics designed to yield data which justify a high degree of confidence and command a high degree of experimental integrity. The flight portion of the experiment will measure independently and in coincidence several physical parameters of cosmic dust particles including speed, direction, energy, and momentum. Its capabilities will provide significant data on the cosmic dust environment in the asteroidal belt and in the vicinity of Jupiter. Author

N69-14805*# California Univ., Berkeley. Space Sciences Lab.
PREDICTION OF THE CORONAL STRUCTURE FOR THE SOLAR ECLIPSE OF SEPTEMBER 22, 1968
Kenneth H. Schatten Sep. 1968 12 p refs Its Ser. 9, Issue 56 Submitted for publication
(Grant NsG-243; Contract Nonr-3656)
(NASA-CR-98587; AD-678898) Avail: CFSTI CSCL 03B

The coronal structure for the solar eclipse of September 22, 1968 has been predicted utilizing a recent model for large-scale structure within the inner corona. Supporting evidence for the model has come from comparisons with interplanetary magnetic field observations, coronal green line emission and comparisons of coronal structures evident in previous eclipses. Author (TAB)

N69-14810# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.
ASTEROIDAL JET STREAMS
H. Alfven Aug. 1968 39 p refs
(Rept.-68-13) Avail: CFSTI

Asteroids may be interpreted as a broken-up planet or as an intermediate state of planetesimal accretion and the purpose of the paper is to compare these two views with observations. The analysis is limited only to the Flora family of asteroids and tables of orbital characteristics and parameters are given. ESRO

N69-14858*# Geological Survey, Washington, D. C.
ADVANCED SYSTEMS TRAVERSE RESEARCH PROJECT REPORT
G. E. Ulrich Jul. 1968 64 p refs *Its* Astrogeology 7
(NASA Order W-12388)
(NASA-CR-98742) Avail: CFSTI CSCL 22A

The Orientale region on the west limb of the moon was selected for preliminary traverse research because of its variety of physiographic features and its potential for solving many of the broader lunar problems. The origin and geologic history of the Orientale basin have been variously attributed to volcanism, tectonism, and to impact by an asteroid-sized body. The movement of lunar surface vehicles and the landing of flying units will be affected by crater density and geometry, small-scale surface roughness, and the mechanical properties of surficial materials. Topographic definition is a first step in estimating these properties. A group of missions combining an intermediate-length manned traverse of approximately 400 km with automated vehicle missions at both ends is proposed for studying the basin. It is strongly recommended that new Orbiter photography, designed for high-quality photogrammetric reduction, be obtained of areas being seriously considered for extended lunar traverses. Author

N69-14859*# Geological Survey, Washington, D. C.
LUNAR GEOLOGICAL FIELD INVESTIGATIONS
G. A. Swann Aug. 1968 11 p refs *Its* Astrogeology 9
(NASA Order W-12388)
(NASA-CR-98743) Avail: CFSTI CSCL 22A

The moon offers an opportunity to test hypotheses based on terrestrial observations that bear on the geologic history of the earth. The Apollo Lunar Geology Experiment should provide sufficient information to determine the general nature of the processes that filled the mare basins and that modify their surfaces. The basic systems capability for more extended exploration of the moon has been built through the development of the Apollo system, and it is recommended that this system be fully utilized for extended lunar exploration. Author

N69-14861*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MATCHED CONIC SOLUTIONS TO ROUND TRIP INTERPLANETARY TRAJECTORY PROBLEMS THAT INSURE STATE-VECTOR CONTINUITY AT ALL BOUNDARIES
Victor R. Bond Washington Jan. 1969 38 p refs
(NASA-TN-D-4942) Avail: CFSTI CSCL 22C

A technique is presented for computing the matched-conic solutions of interplanetary trajectories for use as reference trajectories in guidance and navigation simulations. Continuity in position, velocity, and time at the sphere of influence is insured. The chief advantage of the matching technique is its capability of being adapted to several mission types. Examples are presented of the types of missions considered: the free-flyby mission, the powered-flyby mission, and the stopover mission with a parking orbit about the target planet. Author

N69-14877* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A PROGRAM ANALYSIS FOR LUNAR EXPLORATION
25 Jul. 1967 81 p refs
(Contract NAS7-100)
(NASA-CR-98706; JPL-760-5) Avail: CFSTI CSCL 22A

The purpose of this study is to describe a logical group of goals and then to examine the mission plans for a lunar exploration program directed toward understanding the nature of the Moon. Previous studies such as those of the National Academy of Sciences and the President's Science Advisory Committee have served to outline the major objectives, scope, and pace of a post-Apollo lunar program. In the present study the interrelationships among objectives have been examined for their effect on experimental strategy, and development plans have been studied to identify the combinations of existing and new systems that could be used to carry out the program. In order to emphasize questions of immediate interest, attention has been focused on (1) priority questions in the scientific rationale, and (2) near-future engineering developments. Later goals such as exploitation of lunar resources and operation of lunar bases are excluded. Author

N69-14923*# Volt Information Sciences, Inc., Washington, D. C.
ON THE MAGNETOHYDRODYNAMICS MECHANISM OF SOLAR ACTIVITY
Alexandre Dauvillier Greenbelt, Md. NASA. Goddard Space Flight Center 16 Dec. 1968 8 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 267, Ser. B, No. 14, 14 Oct. 1968 p 840-845
(Contract NAS5-12487)
(NASA-CR-98724; ST-SP-CLG-10785) Avail: CFSTI CSCL 03B

It is shown how the differential rotation could be sustained by coupling, at resonance, an oscillation of the photosphere with the rotation period using the effect of planetary tides, and how the latter modulate the activity within the 11-year period. It is also shown how the toroidal field is concentrated and expulsed from the photosphere by vortices due to the Coriolis forces, and how, finally, this field is sustained by the disruptive discharges consisting the granulation. Author

N69-14943*# International Information, Inc., Philadelphia, Pa.
THEORY OF MOTION OF THE PLANET PLUTO. PART 2: PLUTONIAN PERTURBATION OF THE SECOND ORDER WITH RESPECT TO PERTURBING MASSES. PART 3: RECALCULATION OF FIRST-ORDER PLUTONIAN PERTURBATIONS WITH RESPECT TO PERTURBING MASSES. PART 4: NEW ELEMENTS OF PLUTO [TEORIYA DVIZHENIYA PLUTONA. CHAST' VTORAYA. VOZMUSHCHENIYA PLUTONA VTOROGO PORYADKA OTNOSITEL'NO VOZMUSHCHAYUSHCHIKH MASS. CHAST'TREY'YA. PEREVYCHISLENIYE VOZMUSHCHENIY PLUTONA PERVOGO PORYADKA OTNOSITEL'NO VOZMUSHCHAYUSHCHIKH MASS. CHAST'CHETVERTAYA. NOVYYE ELEMENTY PLUTONA]
Sh. G. Sharaf et al Washington NASA Jan. 1969 180 p refs Transl. into ENGLISH from Tr. Inst. Teor. Astron. (Moscow), v. 10, 1964
(Contract NASw-1499)
(NASA-TT-F-491) Avail: CFSTI CSCL 03C

The Plutonian perturbations of the second order are determined in relation to the masses of Jupiter, Saturn, and Uranus. The Laplace-Newcomb method is utilized for the calculations. Newcomb operators, as related to mean anomalies, are employed in the calculation of the perturbation function. The equations of motion are obtained, the second members evaluated, and formulas presented for the determination of long-period terms by a more convenient method. Then the Plutonian perturbations of the first order are determined once again in relation to the masses of the large planets, using the new elements of Pluto, while increasing the accuracy of the

development of the perturbing function, and while using formulas transformed by the long-period perturbations of Pluto due to Uranus. Tables of coefficients of Newcomb operators are presented. The Plutonian elements are corrected according to observations made between 1914 and 1958. Author

N69-14944*# International Information, Inc., Philadelphia, Pa.
THEORY OF MOTION OF THE PLANET PLUTO. PART 1: PLUTONIAN PERTURBATIONS OF THE FIRST ORDER WITH RESPECT TO PERTURBING MASSES [TEORIYA DVIZHENIYA PLUTONA. CHAST'PERVAYA. VOZMUSHCHENIYA PLUTONA PERVOGO PORYADKA OTNOSITEL'NO VOZMUSHCHAYUSHCHIKH MASS]
Sh. G. Sharaf Washington NASA Jan. 1969 148 p refs Transl. into ENGLISH from Tr. Inst. Teor. Astron. (Moscow), v. 4, 1955
(Contract NASw-1499)
(NASA-TT-F-490) Avail: CFSTI CSCL 03C

Perturbations of the first order by the four large planets were determined. A preliminary improvement of Bauer's elements was performed, based on observations made between 1914 and 1951. Newcomb's method of expanding the perturbation function, the methods of controlling the operator coefficients, and the technique for calculating the expansion coefficients of the perturbation function on analytic computers are outlined. Methods for determining the perturbations of the logarithm of the radius vector, length of the orbit; length of the node and inclination, and the constants of integration are given as well as the perturbations by Neptune between 1912 and 1955. A summary of the Plutonian observations and of the normal positions is presented as well as a method for correcting the elements applied to Pluto and the new Plutonian elements. The symbolic expansion of the perturbation function, a table of operator coefficients, the partial values of the operators for computing corrections for the second term, and some errors in the expressions for Newcomb's operators are included. Author

N69-14951*# Geological Survey, Norman, Okla.
REMANENT MAGNETISM IN METEORITES
Robert L. du Bois and Donald P. Elston Aug. 1968 18 p refs Submitted for publication *Its* Astrogeology 8
(NASA Order W-12388)
(NASA-CR-98740) Avail: CFSTI CSCL 03B

Thirty-three new measurements of natural remanent magnetism (NRM) are reported for several classes of chondrites and achondrites. The data are tabulated with published NRM values for chondrites, irons, and one stony-iron, and are arranged to reveal possible interrelationships among some of the classes. Data for the stony meteorites are grouped by chondrite and achondrite classes, and data for the stony-irons and irons are arranged with respect to gallium-germanium (Ga–Ge) groups. The NRM data are presented graphically, and averaged NRM values for the meteorite classes or groups are summarized. The new remanent magnetic data were obtained from measurements made with an astatic magnetometer. For measurement, the specimens were affixed within a plastic cube, unmodified from their field or museum condition, and eight measurements of the X-, Y-, and Z- components of the remanence were made, from which intensity and direction of the natural magnetism were calculated. Author

N69-14956# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF THE MULTI-IMPULSE OPTIMAL RENDEZVOUS OF MEDIUM DURATION, BETWEEN NEAR-CIRCULAR, NON COPLANAR, CLOSE ORBITS [CONTRIBUTION A L'ETUDE DES RENDEZ-VOUS, MULTI-IMPULSIONNELS OPTIMAUX, DE DUREE MOYENNE, ENTRE ORBITES QUASI-CIRCULAIRES, PROCHES, NON COPLANAIRES]
Jean-Pierre Marec 1968 40 p refs In FRENCH; ENGLISH summary Presented at the 2d Intern. Colloq. on the Optimization Methods, Akademgorodok, U.S.S.R., 20–26 Jun. 1968 Submitted for publication
(ONERA-TP-590) Avail: CFSTI

This analytical study is a first approach to the problem of optimal rendez-vous (minimum fuel consumption for a thruster capable of delivering impulses) between non coplanar, close orbits of small eccentricity, when the duration is sufficiently large: the relative error on the consumption is of the order of the inverse of the square of the transfer angle. The zones of the reachable domain (in the space of the variations of the orbital elements) corresponding to certain six- and five impulse solutions are studied in detail. Author (ESRO)

N69-14967*# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
STUDIES OF EXTRATERRESTRIAL DUST AT 40 KILOMETERS Final Report, 1967–1968
R. Wood Sep. 1968 23 p refs
(Contract NASw-1623; Proj. 57017)
(NASA-CR-98744; Rept-3248) Avail: CFSTI CSCL 03B

The work reported was a continuation of an effort begun in 1966 to investigate the nature and composition of extraterrestrial dust. This effort involved the development of a unique, high-volume particle sampler designed for balloon-borne operation at 40 km. To date, four balloon flights of this sampler have been performed. While these flights have demonstrated that the sampler is capable of achieving all performance objectives, the acquisition and recovery of a sample of extraterrestrial dust has not been accomplished. In reviewing these attempts, no common cause of failure is indicated; each flight has presented an entirely different set of circumstances. Author

N69-15014# Konkoly Observatory, Budapest (Hungary).
IDENTIFICATION LIST OF THE NEW VARIABLE STARS NOMINATED IN 1968
B. V. Kukarkin, Yu. N. Efremov, M. S. Frolov, G. I. Medyedeva, V. P. Fedorovich et al 8 Nov. 1968 43 p *Its* Inform. Bull. No. 311
Avail: CFSTI

Presented is a list of identifying measurements on new variable stars observed during 1968. G.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N69-13946*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LAUNCH DYNAMIC ENVIRONMENT OF THE SURVEYOR SPACECRAFT
George L. Parker 15 Sep. 1968 77 p
(Contract NAS7-100)
(NASA-CR-98571; JPL-TR-32-1289) Avail: CFSTI CSCL 22A

The dynamic environment of the Surveyor dynamic models and operational spacecraft during the boost phase of flight is defined. The data acquisition systems and analysis techniques are discussed. Summary flight data from each of nine spacecraft launches for all measured periods of high acoustic energy and random vibration are included. Also included are the transient responses to various pyrotechnic, staging, and jettison events of the boost phase. Author

N69-13959*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLIGHT PROJECTS, FOR THE PERIOD JULY 1 TO AUGUST 31, 1968
30 Sep. 1968 73 p
(Contract NAS7-100)
(NASA-CR-98572; JPL-SPS-37-53-Vol-1) Avail: CFSTI CSCL 22

A summary of the status of the Mariner Mars 1969 project is reported. The first system test on the first flight spacecraft was completed and space simulator testing was begun. The proof-test model test program, assembly of the second flight spacecraft, and buildup of the third, except for the science payload and the temperature control flux were completed. Revisions, accomplishments, and efforts are summarized for the project engineering, systems, engineering mechanics, and guidance control phases. Materials testing and environmental testing for the program are reviewed. State of the art technology applicable to future planetary missions are also reported. The studies included work on power subsystems, high velocity shock tester, and propulsion. B.P.

N69-13996# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET AMF-2-116 LAUNCHED AT CHURCHILL RESEARCH RANGE
22 Apr. 1968 25 p refs
(SRFB-017; PD-5399) Avail: CFSTI

The engineering aspects of preparing the payload and the launching of Black Brant rocket AMF-II-116 on 22 April 1968 at Churchill Research Range at night, during sustained and distinct auroral activity are reported. This vehicle carried recoverable experiments to provide photographic and photoelectric auroral analysis, vacuum ultraviolet and density measurements, together with a plasma probe, Wadsworth spectrograph, several photometers and an oxygen atom probe. AMF-II-116 malfunctioned, achieving an apogee of only 61,500 feet, resulting in failure of the experimental objectives. Author

N69-14010*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIME REQUIRED FOR AN ADEQUATE THERMAL-VACUUM TEST OF FLIGHT MODEL SPACECRAFT
A. R. Timmins Washington Dec. 1968 23 p refs
(NASA-TN-D-4908) Avail: CFSTI CSCL 22B

This report presents data from the thermal-vacuum tests of 11 flight spacecraft. The data show that total test time is not as important as the time required at four kinds of thermal stress levels. The data base was chosen to include three programs of differing complexity and differing test emphasis, prior to the system test. The individual and collective data indicate a minimum thermal-vacuum system test time of 13 days regardless of the prior test program. The 13 days need to be distributed as follows: 1, 4, 4, and 4 for ambient, transient, cold, and hot thermal-vacuum environments, respectively. Author

N69-14033*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A WIND PROFILE FOR GENERATING CONTROL REQUIREMENTS FOR ROCKET VEHICLES USING LIQUID-INJECTION CONTROL SYSTEMS
Carl J. Daniele and Fred Teren NASA Dec. 1968 31 p refs
(NASA-TM-X-1708) Avail: CFSTI CSCL 22B

A synthetic wind profile with a plateau 5700 meters in width and which drops linearly from this plateau to zero wind velocity at zero altitude and to zero wind velocity at 20-km altitude was found to be the best fit of the type investigated to ten real winds with 90 to 95 percent peak wind velocities measured at the Eastern Test Range. Deflection-impulse requirements were obtained by using this new profile. These requirements were compared to those obtained for the ten real winds for five typical solid launch vehicles, and good agreement was obtained. To illustrate the use of the new synthetic profile, thrust-vector control (TVC) injectant requirements were then calculated for the five launch vehicles for 99 percent winds. Author

N69-14320# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
GRAVITY-GRADIENT STABILIZATION RESULTS FROM THE DODGE SATELLITE IN 1967
F. F. Mobley Jul. 1968 39 p refs
(Contract NOw-62-0604)
(AD-677270; APL-TG-993) Avail: CFSTI CSCL 22/1

The DODGE Satellite was launched into a 7 degrees, near-synchronous orbit on July 1, 1967. Residual spin was removed in 12 days by artificial magnetic hysteresis damping. The four booms of the X configuration were deployed to achieve gravity capture. A sample-and-hold technique was used to damp librations by reacting with the earths magnetic field. Pitch and roll damped to 20 degree peaks in 9 days. Efforts to obtain better stabilization with the torsion-wire damper-boom system were unsuccessful. Subsequent stabilization with magnetic damping showed one period of exceptionally good results with pitch and roll peaks of only 4 degrees. The satellite tumbled on November 16-17, possibly due to a meteoroid of the Leonid shower. TV cameras of 22 degree and 60 degree fields have provided attitude data. A color filter system in the 22 degree camera has allowed the first color pictures of the full earth image. Author (TAB)

N69-14538*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
METEOROID HAZARDS IN DEEP SPACE Final Report
H. Chaess, S. Chandra, R. Grenda, R. Lambert, S. Neste et al [1968] 95 p refs
(Contract NAS9-8104)
(NASA-CR-92399) Avail: CFSTI CSCL 22B

This report describes the development of the Sisyphus meteoroid detection scheme for use on interplanetary research vehicles. The system concept is described, which reflects a shift in emphasis from the Voyager concept of interplanetary exploration to systems compatible with the Mariner and Pioneer type of spacecraft. The concept makes use of the solar radiation reflected from the meteoroid for detection, range, and velocity measurements. Three optical systems, coupled to photomultipliers and having overlapping conical fields of view, detect any meteoroid passing through the overlap region. This report specifically covers: (1) the false alarm rate expected on Sisyphus; (2) the signal and noise error analysis; (3) the two-cone Sisyphus system (assuming mechanical failure of the third and redundant subsystems); (4) solution for a Sisyphus system of generalized geometry; and (5) the Sisyphus optical design study. Possible errors which could arise in the use of the Sisyphus system are discussed. K.W.

N69-14776# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France).
INTEGRATION AND ACCEPTANCE TESTS OF EXPERIMENT FU-171 "KERGUELEN" (WAVE AND PARTICLE INTERACTION IN THE MAGNETOSPHERE) [COMPTE-RENDU D'ESSAIS D'INTEGRATION ET DE RECEPTION DES TETES DE FUSEES, EXPERIENCE FU 171 "KERGUELEN" (INTERACTION ENTRE ONDES ET PARTICULES DANS LA MAGNETOSPHERE]
J. Fillatre, P. Haye, P. Bardin, and J. Raffin 16 Jan. 1968 205 p In FRENCH Presented at the CNES Symp. on Space Technology, Bretigny, France, 12 Mar.-2 Apr. 1968
Avail: CFSTI

An analysis is made of component tests, tests after assembly and preflight tests performed on three sounding rocket payloads intended to study the interaction between waves and particles in the magnetosphere. Results of each tests are given with charts or tables. ESRO

N69-14787# European Space Research Lab., Noordwijk (Netherlands).
HEOS-A SATELLITE: BRIEF DESCRIPTION OF SCIENTIFIC EXPERIMENTS
B. G. Taylor Paris ESRO Oct. 1967 34 p
(ESRO-SN-19(ESLAB)) Avail: CFSTI

The HEOS-A satellite, the third to be developed by the European Space Research Organization, will be launched by a Thor-Delta vehicle from the Cape Kennedy range towards the end of 1968 or early in 1969. Its orbit will be highly elliptical, with an apogee of about 250,000 km and an inclination of 28.5°. The general aim of the satellite is to measure the magnetic and particle environment in the magnetosphere and in interplanetary space near the time of the solar maximum. The present report outlines the specific objectives and mode of operation of the seven on-board experiments. Author (ESRO)

N69-14796# Sud-Aviation, Cannes (France). Div. Engins Spatial et Electronique.
JOINTS FOR GRAVITY GRADIENT SATELLITES [LES ARTICULATIONS POUR SATELLITES STABILISES PAR GRADIENT DE GRAVITE]
B. Hubert 1968 11 p In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

In gravity gradient satellites the joints perform the coupling between the body and the mobile arms of the satellite: they are characterized by their stiffness and their damping coefficient. Two types have been developed by Sud-Aviation: an Eddy current joint and a magnetic hysteresis joint. In both cases the stiffness is obtained by the means of a torsion wire. ESRO

N69-14827# Royal Aircraft Establishment, Farnborough (England).
DATA HANDLING EQUIPMENT FOR BRITISH SATELLITES
A. Laws and H. D. Fisher May 1968 24 p refs Presented at the 5th Intern. Aerospace Instrumentation Symp., Cranfield, Engl., Mar. 1968
(RAE-TR-68105) Avail: CFSTI

The paper reviews the experience gained in the production of the data handling equipment for the Ariel 3 satellite, and shows how this experience has influenced the design of similar equipment for the Black Arrow satellites. A brief description is given of the P.F.M. system used in Ariel 3 and the P.C.M. system to be in the Black Arrow satellites. The techniques used in the manufacture of the equipments are discussed in some detail. Author (ESRO)

N69-14830# Royal Aircraft Establishment, Farnborough (England).
TABLE OF EARTH SATELLITES LAUNCHED IN THE YEARS 1957 TO 1967
Eileen Quinn and D. G. King-Hele May 1968 172 p refs
(RAE-TR-68124) Avail: CFSTI

All known artificial satellites launched before 1 January 1968 are listed chronologically. Lifetimes, weights, dimensions and orbital details are given for instrumented satellites and their final-stage rockets. Other fragments from satellites are listed without these details. The methods used in compiling the table are described. The complete table is being re-issued because several thousand improvements have been made since the previous issue in February 1967. Author (ESRO)

N69-14836*# TRW Systems Group, Houston, Tex.
APOLLO SATURN SPACE VEHICLE POGO ANALYSIS, ADDENDUM 1 Project Status Technical Report, Period Ending 20 Sep. 1968
R. A. Winje 20 Sep. 1968 164 p refs
(Contract NAS9-8166)
(NASA-CR-92455; TRW-11176-H001-R0-01) Avail: CFSTI CSCL 22B

An assessment of the low frequency longitudinal vibration (POGO) has been made for the AS-503 manned vehicle during S-1C burn. This work is an extension of earlier Saturn 5 POGO studies. Changes in the stability results are reported which update the mathematical model, including: (1) the 102-degree-of-freedom structural dynamic characteristics model data for AS-503; (2) fuel and LOX suction line compliance data as of July 1968; (3) fuel suction line compliance data as of 30 August 1968; (4) inboard engine cutoff at 125 sec after liftoff. A summary of the equations and parameter values is given. Linear stability analyses were performed for the basic configuration, with accumulators in all five LOX suction lines, and with accumulators in the four outboard LOX suction lines. Analyses were performed at seven times of flight for four structural modes: the first and second structural modes, a mode associated with the Stage I LOX tank bulging, and a mode associated with the inboard engine cross beam assembly motion. K.W.

N69-14852# Société Européenne d'Etude et d'Intégration de Systèmes Spatiaux, Courbevoie (France).
PRINCIPLES OF ATTITUDE CONTROL OF THE P.A.S. SATELLITE [PRINCIPE DU CONTROLE EN ATTITUDE DU SATELLITE P.A.S.]
Marcel Cassou, Arlette Lemarchand, and Francois Turck 1968 58 p In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

The launch sequence of EUROPA-2 three stage launcher is reviewed and problems linked with positioning and station keeping of the satellite are discussed. Attitude evaluation and control are analyzed for both the ascent and the final trajectories. Accuracy of the measurement of the reference directions is discussed. ESRO

N69-14853# Technische Hochschule Stuttgart (West Germany). Inst. fuer Mechanik.
DAMPING CRITERIA FOR GRAVITY GRADIENT SATELLITES [CRITERES D'AMORTISSEMENT POUR SATELLITES STABILISES PAR GRADIENT DE GRAVITE]
Manfred Hiller 1968 12 p refs In FRENCH Presented at the CNES Intern. Colloq. on Satellite Attitude and Stabilization, Paris, 8–11 Oct. 1968
Avail: CFSTI

Different ways of producing a damping effect for passive stabilization of satellites are listed. Qualificative criteria are analyzed and applied to some of the satellites or satellite projects. ESRO

N69-14927# European Space Vehicle Launcher Development Organization, Paris (France).
THE F-7 LAUNCH OF EUROPA-1
In ESRO ESRO/ELDO Bul. No. 3 Nov. 1968 p 4–8 In FRENCH and ENGLISH (See N69-14926 04-34)
Avail: CFSTI

The launching program of EUROPA-1 launch vehicle scheduled for November at Woomera (Australia) is described. This firing, known as F-7, is the eighth firing in the ELDO program. The three stages are fully representative. The spacecraft is equipped with the necessary tracking, measurement recording, and telemetry equipment together with a radio command. The objectives of this trial are demonstration of engine performance of the three stages, stage separation, and injection of satellite into orbit together with demonstration of guidance system performance and of tracking networks. ESRO

N69-14931# European Space Research Organization, Paris (France).
PROGRESS IN OPERATIONAL PROGRAM
In its ESRO/ELDO Bul. No. 3 Nov. 1968 p 38–43 In FRENCH and ENGLISH (See N69-14926 04-34)
Avail: CFSTI

The progress in the ESRO operational campaign comprising sounding rocket launchings and the experiments performed is reported and the schedule of remaining launchings for 1968 is given. The ESRO 1 (aurorae) and ESRO 2 (IRIS) successful launches and progress in HEOS and TD projects are also stated. ESRO

N69-14942# European Space Research Organization, Paris (France).
PROGRESS IN OPERATIONAL PROGRAM
In its ESRO/ELDO Bull. No. 2 Aug. 1968 p 34-40 In FRENCH and ENGLISH (See N69-14937 04-34)
Avail: CFSTI

The ninth sounding rocket campaign conducted by ESRO from Sardinia was concluded in May 1968. Two Centaure rockets, one Belier and one Dragon were launched and their payloads are described. The present situation concerning the ESRO 1, ESRO 2 and HEOS-A2 satellites is briefly outlined. ESRO

N69-15017*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ORBITING ASTRONOMICAL OBSERVATORY A-2 SPACE VEHICLE RESPONSE TO TRANSIENT LOADINGS AT ATLAS BOOSTER ENGINE CUTOFF
J. A. Garba and R. D. Simpson 21 Dec. 1968 326 p refs
(Contract NAS7-100)
(NASA-CR-98694; JPL-900-231) Avail: CFSTI CSCL 22B

The specific problem of predicting the structural response of the Orbiting Astronomical Observatory (OAO A-2) spacecraft during Atlas booster engine cutoff is treated, with respect to the normal mode analysis and the response analyses. The mathematical model of the Atlas Centaur-OAO A-2 vehicle is depicted, and tabulations give the numerical values for the joint coordinates, spring constants, and joint inertias of the torsion model. Plots of the first 19 free-free normal modes of the composite vehicle are included, and pertinent information on modal deflection and torque parameters are tabulated. The time histories of the responses were computed, together with their Fourier transforms. In addition, the vehicle transfer function at each joint was also computed. Acceleration responses and torque responses for 3% modal damping are given. Time histories and Fourier transforms are graphed. M.G.J.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N69-13919 Texas Univ., Austin.
A CRITICAL EVALUATION OF THE METHOD OF LEHMANN AND MAEHLY FOR FINITE DEGREE-OF-FREEDOM SYSTEMS
Paul Monroe Kenner (Ph.D. Thesis) 1967 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-4300

The Lehmann-Maehly method for computing upper and lower bounds to the eigenvalues of a self-adjoint operator is evaluated as a procedure for determining the natural frequencies and modes shapes of finite degree of freedom systems. The evaluation is based on comparisons of the results obtained by the Lehmann-Maehly method with those obtained by a standard iteration procedure for a string bead problem and a finite degree of freedom model of a uniform cantilever beam of angular cross section. For these comparisons, the Lehmann-Maehly method is applied directly to the operator, A, entering the usual eigenvalue problem, and also to a Kato type operator, H (defined in terms of operators Q, Q*, which are such that A = Q*Q), in a modification of the method introduced by Bazley and Fox. Dissert. Abstr.

N69-13992 California Univ., Berkeley.
FIRST ORDER FREQUENCY EFFECTS IN SUPERSONIC PANEL FLUTTER OF FINITE CYLINDRICAL SHELLS
Ting-Mau Li (Ph.D. Thesis) 1967 49 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-5765

The flutter boundary of a thin cylindrical shell of finite length is determined with the aerodynamic load obtained by linearized potential theory. A low frequency approximation is applied together with some other plausible approximation, to circumvent the difficulty in evaluating a complicated convolution integral containing Bessel functions. Galerkin's method is then used to set up an eigenvalue problem equivalent to the resulting integro-differential equation. The flutter boundary, for given Mach number and circumferential mode, corresponds to the shell thickness ratio at which the real part of any one of the eigenvalues first become non-negative. Some interesting conclusions can be drawn, at least qualitatively, through HADAMARD's well known theorem on the regularity of a matrix. In particular, it is found that the most feasible circumferential mode of vibration occurs around n = 7. Dissert. Abstr.

N69-14129*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
INFLUENCE OF NORMAL PRESSURE ON THE NATURAL-OSCILLATION FREQUENCIES OF NEARLY CYLINDRICAL SHELLS [VLIYANIYE NORMAL'NOGO DAVLENIYA NA CHASTOTY SOBSTVENNYKH KOLEBANIY OBOLOCHEK, MALO OTLICHAYUSHCHIKHSYA OT TSILINDRICHESKIKH]
S. Shukurov Washington NASA Dec. 1968 9 p refs
(Contract NASw-1692)
(NASA-TT-F-12011) Avail: CFSTI CSCL 20K

The dynamic behavior of thin isotropic, nearly cylindrical shells under static normal loads is discussed. The effect of deviations from a perfect cylindrical form on the natural oscillations of such shells is determined. A solution is obtained by a small-parameter method previously used for static problems and stability problems of such shells. The maximum deviation of the shell from a perfect form is assumed to be the small parameter in this procedure. Author

N69-14131# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATION METHOD OF THE DETERMINATION OF FREQUENCIES OF NATURAL VIBRATIONS OF CYLINDRICAL, CONICAL, AND TOROIDAL SHELLS [PRIBLIZHENNYY METOD OPREDELENIYA CHASTOT SOBSTVENNYKH KOLEBANIY TSILINDRICHESKIKH, KONICHESKIKH I TOROIDAL'NYKH OBOLOCHEK]
I. I. Meyerovich 1 Dec. 1967 37 p refs Transl. into ENGLISH from the book "Prochnost i Dinamika Aviatsionnykh Dvigateley" Mashinostr., Moscow, 1965 p 148-172
(AD-677020; FTD-MT-24-06-67) Avail: CFSTI CSCL 13/13

Flexural vibrations of shells of revolution are studied, assuming the existence of nodal lines along meridians and parallels. The characteristic equation for determining the square of the natural frequencies is simplified by imposing certain constraints on displacement components. The Ritz method is used with approximation functions which satisfy the boundary conditions, under assumptions that there are no tensional vibrations in the circumferential direction, and no shear in the middle surface. The expediency of the hypotheses used here is verified in investigating the vibrational behavior of cylindrical, conical, and toroidal shells. The advantage of the proposed method is that it leads to simple design formulas. TAB

N69-14142# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FREE OSCILLATIONS OF RECTANGULAR PLATES OF VARIABLE THICKNESS WITH ASYMMETRICAL BOUNDARY CONDITIONS [VIL'NI KOLYVANNYA PRYAMOKUTNYKH PLASTYN ZMINOYI TOVSHCHYNY PRI WESYMETRY-CHNYKH GRANYCHNYKH UMOVAKH]
V. G. Tretyak 19 Sep. 1967 13 p refs Transl. into ENGLISH from Prikl. Mekhan., v. 9, no. 4, 1963 p 381-386
(AD-677004; FTD-HT-67-341) Avail: CFSTI CSCL 13/13

This article attempts to extend an analysis of rectangular plates with asymmetrical boundary conditions, the thickness of which varies in one direction. The problem is treated as a linear one. The plate material is considered to be elastically isotropic. The analysis of dynamic loading of plates is considered as one of the most important steps in the design of parts in present-day machine construction. A promising method of shell analysis based on the variational principle has been stated. TAB

N69-14156# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VARIABLE FLEXIBILITY TETHER SYSTEM Final Report, May 1967-Feb. 1968
Philip J. Rader Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. Sep. 1968 104 p refs
(Contract F33615-67-C-1725)
(AD-677687; AFAPL-TR-68-19) Avail: CFSTI CSCL 22/1

The purpose of this development program was to design, fabricate, and test a prototype variable flexibility tether system, which by virtue of its controllable rigidity and remotely actuated manipulator, may be used as a simple safety tether, a translation aid, an astronaut attachment and positioning tool and a means of moving and recovering objects in space. Author (TAB)

N69-14169*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A STUDY OF STIFFNESS MATRICES FOR THE ANALYSIS OF FLAT PLATES
Dennis A. Kross Washington Dec. 1968 47 p refs
(NASA-TN-D-4927) Avail: CFSTI CSCL 20K

The analysis of thin plates in bending is considered with four different rectangular finite element representations. The first representation approximates the transverse displacement by a sixth-order two-dimensional generalization of a Hermitian interpolation polynomial. This representation requires that the Kirchhoff hypothesis be satisfied throughout the element. Therefore the transverse shear strains vanish, and the element exhibits no shear stiffness. The second representation uses a simple bilinear approximation for the transverse displacements and rotations without the Kirchhoff hypothesis. In the latter case both shear-stiffness and bending-stiffness matrices are obtained. The third approximation use a discrete Kirchhoff hypothesis which introduces a constraint between the transverse nodal displacements and nodal rotations. This case also contains both bending and shear stiffness. The fourth representation uses only the bending stiffness developed in the previous case. This is a logical approximation since the discrete Kirchhoff hypothesis causes the transverse shears to vanish in the limit. Numerical examples are presented to demonstrate the relative accuracy of the finite elements investigated. Author

N69-14182 Syracuse Univ., N. Y.
THE EFFECT OF TESTING SYSTEM STIFFNESS ON FRACTURE BEHAVIOR OF SHEET SPECIMENS
Khushwant Singh Grewal (Ph.D. Thesis) 1967 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-5463

The effect of testing systems stiffness on the fracture behavior of Al 7075-T6, Al 2024-T3 and T351, Ti RS-140 (solution treated, aged at 700°F, and aged at 900°F), AISI 4340 steel tempered at 900°F, and type 301 stainless steel 60% cold reduced, was investigated, using center-cracked or single edge-notch specimens. Notch strength of relatively ductile materials, i.e., Al-2024-T3 and T-351, Ti RS-140 solution treated, AISI 4340 tempered at 900°F and type 301 stainless steel was found to decrease with a decrease in system stiffness. The notch strength of the remaining materials, which were relatively brittle, was not affected. These results are explained on the basis of discontinuous crack propagation. For Al 2024-T3 and T-351 specimens, the shear fraction of the fracture surface was higher in those tested in the dead weight loaded machine than that in specimens tested in the stiff machine. Theoretical analyses of the effect of testing system stiffness on fracture, based on both energy and stress criteria of fracture, are given. Dissert. Abstr.

N69-14185# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
APPROXIMATE FUNCTIONS AS PARTICULAR SOLUTIONS IN THERMAL-STRESS ANALYSIS OF AN OGIVAL RADOME
Manford B. Tate Aug. 1968 22 p refs
(Contract NOw-62-0604)
(AD-677272; APL-TG-1007) Avail: CFSTI CSCL 17/9

Functions of approximation to particular solutions that occur in the ogival radome thermal-stress problem are presented. It was found by numerical comparisons with the generating differential equations that the approximate closed-form solutions display an error range of no more than plus or minus one-half percent. The solutions were derived to gain two major advantages: first, a reduction of analytical complexity lessens the chance of computational error and, second, certain unwieldiness in numerical work is reduced or eliminated. Computer results for repeated future application in the evaluation of thermal stresses in blunt and pointed radomes of compound-ogive configuration are tabulated. Author (TAB)

N69-14186 Purdue Univ., Lafayette, Ind.
OPTIMAL SYNTHESIS OF RANDOMLY GENERATED LINKAGES
Richard Emil Garrett (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-8304

In an effort to depart somewhat from the classical techniques of mechanism synthesis, a design process is developed whereby the speed of the digital computer is a primary design criterion. By efficient use of basic input-output kinematic relationships and the computer's random number generator, it is possible to obtain four- or six-link mechanisms in a few minutes of computer time without any knowledge of synthesis techniques. Although this approach is presently applied to the design of four- and six-link function generators, it is an approach applicable to coupler-curve, multi-degree of freedom, and three-dimensional synthesis problems. In order to aid in the selection of practical designs, a sensitivity factor for the four-link mechanisms is calculated showing the degree of sensitivity of the mechanism to link length tolerances and joint clearances. Dissert. Abstr.

N69-14195# Atomic Weapons Research Establishment, Aldermaston (England).
USE OF SCANNING ELECTRON MICROSCOPY IN COMPOSITE MATERIALS RESEARCH
C. A. Calow and R. E. Cooper Jul. 1968 14 p refs
(AWRE-O-43/68) Avail: CFSTI

In recent years considerable interest has developed in the concept of composite materials, particularly of the type using strong fibres embedded in a weaker matrix, which can result in a material with unusually high strength and rigidity. Experimental work on suitable model systems has resulted in a good understanding of the principles governing the mechanical properties of such materials, but the production of practical materials still presents many problems. In particular, the use of whisker crystals, which

exhibit extremely high strengths (10^6 psi) is difficult because of their small size—a few microns diameter and a few millimeters in length. The incorporation of fibres into a metal matrix is also difficult. A method is described which is being developed for producing composite materials consisting of aligned sapphire whiskers in a matrix of nickel. Scanning electron microscopy was used at a number of stages in this research and development. Author (NSA)

N69-14204# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REVEALMENT OF HIDDEN PERIODICITIES IN THE PRESENCE OF CORRELATED NOISE [VYYAVLENIYE SKRYTYKH PERIODICHNOSTEY V PRISTUTSTVII KORRELIROVANNYKH SHUMOV]

M. F. Romanov 3 Oct. 1967 14 p refs Transl. into ENGLISH from Tr. Politekhnicheskiy Inst. (Leningrad), no. 252, 1965 p 140-146

(AD-675918; FTD-HT-23-547-67) Avail: CFSTI CSCL 20/11

A method is presented to determine hidden periodic components in the presence of correlated noise. The problem arises in the evaluation of vibration test results. These components are estimated as frequencies and amplitudes observable at discrete times on some finite interval using statistical spectral analysis of time series arising from stationary stochastic processes. D.H.B.

N69-14254*# Case Western Reserve Univ., Cleveland, Ohio.

STRUCTURAL SYNTHESIS OF A STIFFENED CYLINDER

William M. Morrow, II and Lucien A. Schmit, Jr. Washington NASA Dec. 1968 169 p refs

(Grant NsG-110-61)

(NASA-CR-1217) Avail: CFSTI CSCL 20K

The problem of structural synthesis of a cylindrical shell stiffened in the longitudinal and circumferential directions with rectangular cross-section stiffeners is treated. The design variables are the dimensions and spacings of the stiffeners and the thickness of the skin, seven in all. The synthesis method uses the penalty function method of Fiacco and McCormick to transform the basic inequality constrained minimization problem into a sequence of unconstrained minimization problems. The stability analysis of the cylinder is a linear analysis including the effects of stiffener eccentricity. Numerical results are presented which illustrate the effectiveness of the penalty function approach, the importance of multiple load conditions, the influence of internal versus external stiffening, the effect of minimum gage limitations on the optimum design, and the advantage that stiffening in both directions exhibits compared with stiffening in only one direction. Author

N69-14306*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF THE CHEMICAL STATE OF PYROLYSIS GASES ON HEAT-SHIELD MASS

William D. Brewer, C. W. Stroud, and Ronald K. Clark Washington Dec. 1968 27 p refs

(NASA-TN-D-4975) Avail: CFSTI CSCL 20M

Results are presented from an analytical investigation to determine the effect of the chemical state of the pyrolysis gases on the heat-shield mass required for a reentry vehicle in a given environment. Mass per unit area of ablative material required is calculated for a number of constant-heating-rate environments and the total mass is calculated for a lifting-body vehicle in a typical reentry trajectory. The required mass of ablative material is calculated for three different assumptions: (1) The pyrolysis gases are in chemical equilibrium at all times. (2) The gases are chemically frozen at 500°K. (3) The gases change from the frozen state to equilibrium over some temperature range. The results show that in all calculations considerably more material is required if the gases remain chemically frozen as initially formed than if the gases are in equilibrium at all times. For the lifting-body vehicle, 28 percent more material is required if the gases are chemically frozen than if the gases are in chemical equilibrium. Some experimental data are given which indicate that the transition from the frozen state to equilibrium may take place above 1400°K and over a temperature range of about 200°K. Author

N69-14315*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PROJECTILE SHAPE EFFECTS ON HYPERVELOCITY IMPACT CRATERS IN ALUMINUM

B. Pat Denardo Washington Dec. 1968 16 p refs

(NASA-TN-D-4953) Avail: CFSTI CSCL 20K

Linear high density polyethylene cylinders, with fineness ratios of 1/6, 1/3, 2/3, 1, and 3, and spheres were launched into thick targets of hard aluminum at velocities up to 11.3 km/sec. The effects of projectile shape on the various crater parameters were determined quantitatively from the basic crater dimensions: depth, diameter, and volume. In the hypervelocity regime, the dimensionless penetration, P/d, varied with the projectile fineness ratio, l/d, to the 1/4 power for fineness ratios between 1/6 and 1. For fineness ratios greater than 1, the power increased and approached unity, as would be expected from shaped-charge jet theory. For engineering purposes, in the hypervelocity regime, a sphere produces the same crater as a cylinder of equal diameter and l/d of 2/3. Author

N69-14333# Southampton Univ. (England). Inst. of Sound and Vibration Research

THE BENDING TORSION FLUTTER OF A HINGELESS ROTOR BLADE

C. W. Stammers Oct. 1968 46 p refs

(ISVR-TR-9) Avail: CFSTI

A method is described for determining the bending torsion flutter/divergence behavior of a hingeless rotor, with particular reference to the case of forward flight, when the equations of motion contain periodic coefficients. The model considered allows for variations in chord, elasticity, and mass distribution and in the location of the inertia and flexural axes, but quasi-steady aerodynamics are assumed. Results for a representative blade indicate the limits of operation. Under normal operating conditions flutter and divergence are heavily damped and forward flight has a beneficial effect on stability. Author

N69-14334* Texas A&M Univ., College Station.

A RAPIDLY CONVERGING TRIANGULAR PLATE ELEMENT

James A. Stricklin, Walter E. Haisler, Patrick R. Tisdale, and Richard Gunderson [1968] 9 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.

(Grant NGL-44-001-044)

(NASA-CR-98675; SC-CR-68-3561) Avail: CFSTI CSCL 20K

A compatible triangular plate element is presented, based on a complete third order polynomial for the normal displacement and second order polynomials for the inplane displacements. A nine degree of freedom element is obtained by requiring the transverse shear deformations to be zero at the nodes and along the sides of the element, and by assuming the slope normal to the element at the middle of the side is one-half the sum of the values at the corner nodes. Author

N69-14335# Ohio State Univ., Columbus. Engineering Experiment Station.

SPACE ENCLOSURE SYSTEMS

Donald G. Wood Nov. 1968 68 p refs *Its* Bull. No. 205

Avail: Issuing Activity

Basic information is presented on the design and development of space enclosure systems, and on the geometric data and principles of space geometry manipulation upon which to build design developments. All cells are treated in terms of the variables of proportion and dimension available to them as packing cells and

documented specifically with regard to the control patterns governing the variety of specific proportions and dimensions possible to each cell while retaining the ability to pack with reproductions of itself and fill all space. Illustrations afford a visual vocabulary of cell forms and indicate the range of alternatives available to the space enclosure. In some instances the limits of variation of a given cell is indicated; in other cases, limitless variations are possible and in such cases only a selection of possibilities is illustrated. A systematic method of subdividing the packing cells into modules of identical shape and size is documented. Author

N69-14368# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD OF INVESTIGATING THE DISTRIBUTION OF PLASTIC DEFORMATION DURING DYNAMIC LOADING

V. P. Severdenko et al 9 Nov. 1967 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 10, no. 11, 1966 p 847–848

(AD-667223; FTD-HT-23-1098-67) Avail: CFSTI CSCL 20/11

Under static loading a cylindrical specimen deforms uniformly from both ends, but under dynamic loading the plastic deformation is localized at the impacted end of a cylindrical specimen. The cause of nonuniform deformation distribution in specimens depends on the nonuniform distribution of inertia forces in specimens under the effect of which the deformation takes place. A scheme was plotted in order to determine the effect of inertia forces on the deformation propagation induced by dynamic loading. Author (TAB)

N69-14408#

ANALYSIS OF A CIRCULAR CYLINDRICAL SHELL SUBJECTED TO DYNAMIC LOADING

Iu. N. Alekseev and E. A. Limberg [1968] 3 p refs Transl. into ENGLISH from Samoletostroenie i Tekhn. Vozdushnogo Flota, no. 13, 1968 p 118–120

Avail: CFSTI

An infinite, thin, smooth, cylindrical isotropic shell is considered which is under a pulsed load varying along its axis. The general equations of motion are applied in solving the problem under the assumption of incompressibility of the shell wall material. The tangential strain is determined from the continuity equation, and the equations for stress and the boundary condition are given. A second order linear differential equation results; it is used to compute the tangential strains of the cylindrical shell walls in a water tank loaded from within by an instantaneous release of energy. K.W.

N69-14410 Wisconsin Univ., Madison.

STABILITY AND STRESS ANALYSIS OF A MINIATURE SWITCH

James Yun-Yann Hung (Ph.D. Thesis) 1968 84 p

Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-5319

The stability and stress analysis of a miniature switch made from a single piece of metal is mathematically treated. The problem has been divided into two parts. The first part is a stability problem. The mathematical formulation leads to a system of three nonlinear first order differential equations containing four unknown parameters. Given the prescribed displacements at boundaries we must evaluate the four parameters so that the deflected shape obtained from the system of differential equations will satisfy the given boundary displacements. The second part of the problem is the investigation of the stress distribution around the notched portions of the switch blade. Since the superposition principle holds for linear problems, linearity has been assumed and the problem reduced to one of plane elasticity and to one involving the theory of plates. Dissert. Abstr.

N69-14412 Johns Hopkins Univ., Baltimore, Md.

ON THE EXISTENCE AND THE ASYMPTOTIC STABILITY OF SOLUTIONS TO THE EQUATIONS OF LINEAR THERMOELASTICITY

Constantine Michael Dafermos (Ph.D. Thesis) 1967 70 p

Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-6553

The equations of linear, inhomogeneous and anisotropic thermoelasticity are considered. The mixed initial-boundary value problem is formulated and the existence of a unique solution is established. Finally, the problem of the asymptotic behavior of this solution as time grows to infinity is investigated. Dissert. Abstr.

N69-14434#

STABILITY OF A CONICAL SHELL IN SUPERSONIC GAS FLOW

A. A. Izmailov [1968] 3 p refs Transl. into ENGLISH from Mat.-Mekh., Ser. A (Moscow), no. 4, 1968 p 120–125

Avail: CFSTI

The stability of a conical shell is considered performing small axisymmetric vibrations in a supersonic gas flow. The problem is solved for a shell with a small aperture angle without taking account of the inertial force due to tangential displacement. Two differential displacement equations are obtained using the Kirchhoff–Love relationship for the connection between the strain of the middle surface and the displacements, as well as between the stress resultants and moments and the strains, for small axisymmetric vibrations of thin conical shell. The boundary value problems are solved for all possible boundary conditions. Second approximation formulas for the critical velocity are obtained for hinge supported and clamped endface shells. B.P.

N69-14447#

DISPLACEMENT OF A RIGID CYLINDER SUBJECTED TO AN ACOUSTIC PRESSURE WAVE

E. I. Grigoliuk [1968] 7 p refs Transl. into ENGLISH from Prikl. Mekh., v. 4, no. 10, 1968 p 1–5

Avail: CFSTI

The motion is considered of a rigid circular cylinder submerged in an ideal compressible fluid subjected to a plane acoustic wave whose pressure behind the front varies according to step and exponential laws. The problem is solved by an operator method utilizing approximate relationships for the reflected and radiated wave potentials which are suitable for the initial and terminal time intervals. A comparison is given with known exact solutions, and time dependences are presented for the displacement, velocity, and acceleration under the effect of an exponential, and a step, pressure wave. Author

N69-14460#

ON THE STABILITY OF THREE-DIMENSIONAL ELASTIC BODIES

A. N. Guz' 26 Feb. 1968 8 p refs Transl. into ENGLISH from PMM (Kiev), v. 32, no. 5, 1968 p 930–934

Avail: CFSTI

The static stability of a three-dimensional elastic body with small subcritical strains is considered. Because of the assumption of smallness of the subcritical strains the results obtained are applicable to the investigation of the stability of elastic bodies fabricated from a metal and from stiff bonded plastics. These results are also necessary for the latter since bonded plastics have low shear stiffness, hence application of the applied theories sometimes results in large errors in determining the critical forces. Special attention is paid to obtaining general solutions of the static stability equations of a three-dimensional body compressed along the Ox_3 axis by stress resultants of intensity q, and along the Ox_1 and Ox_2 axes by stress resultants of intensity p. Author

N69-14477*# Wichita State Univ., Kans.
SOME EQUILIBRIUM AND FREE VIBRATION PROBLEMS ASSOCIATED WITH CENTRIFUGALLY STABILIZED DISK AND SHELL STRUCTURES
Walter Eversman Washington NASA Dec. 1968 237 p refs
(Grant NGR-17-003-004)
(NASA-CR-1178) Avail: CFSTI CSCL 20K

Equations for shallow, isotropic, spherical shells spinning about their polar axis are derived from a variational principle and specialized to the case of a spinning flat membrane disk. The problem of transverse vibrations is solved for a fully clamped hub and a loosely clamped hub on an annular disk. Vibrational analysis of shallow shells indicates that the spinning shell equilibrium problem must be solved first to provide the necessary stress and displacement distributions for the vibration equations of motion. The equilibrium problem is treated by linear theory for a freely spinning shell and by both linear and nonlinear theory for the spinning shell with a fully clamped hub. It is found that bending effects are important, particularly for shells with a small ratio of rise to thickness, and that a continuous transition from the shell solution to that for a spinning flat disk requires that bending be included. The nonlinear effect of finite rotations of shell elements is found to be strong and increases as the ratio of shell rise to shell thickness increases. It is concluded that a nonlinear theory which includes both membrane and bending effects should be employed for the general analysis of the equilibrium configuration. Author

N69-14480*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF RADIUS ON BULGING AND FRACTURE OF THROUGH-CRACKED CYLINDRICAL PRESSURE VESSELS AT CRYOGENIC TEMPERATURES
Timothy L. Sullivan and William S. Pierce Washington Dec. 1968 28 p refs
(NASA-TN-D-4951) Avail: CFSTI CSCL 20K

Burst tests of through-cracked, thin-walled cylinders fabricated from Ti-5Al-2.5Sn, extra low interstitial grade, and 2014-T6 Al were conducted at −320° and −423° F (77 and 20 K). The diameters of the cylinders tested were approximately 6 and 18 in. (15 and 46 cm). The titanium alloy test results showed the pressure bulge coefficient was essentially constant for these two diameters. Comparison of the experimental results with an expression for predicting hoop fracture stress proposed by Eiber showed a good fit with the aluminum alloy data but a poor fit with the titanium alloy data. Author

N69-14506*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN IMPACT ENERGY-ABSORBING STRUT EMPLOYING TUBE CUTTING
Robert W. Warner and Arthur G. Kaskey Washington Dec. 1968 38 p refs
(NASA-TN-D-4941) Avail: CFSTI CSCL 20K

An experimental evaluation is described for a tubular, nontelescoping, pin-ended strut that absorbs impact energy by tube cutting. Since this strut is shorter than a two-part telescoping strut, it offers a means for reducing the wieght of any energy-absorbing truss (or other structure) in which a short strut is appropriate. The cutting load is reasonably constant over the stroke and repeatable for the impact velocities tested, which ranged from 3.0 to 11.9 feet per second, and for variations in impact weight, stroke length, and precutting. The lower and more meaningful of the two specific energy absorptions evaluated herein (5893 ft-lb per lbm) is obtained by dividing the product of the mean cutting load and the maximum possible stroke by the total strut weight (including end fittings). When modified in overall strut length, material, and number of cutters, as a check on adaptability, the system continued to function successfully. Author

N69-14517# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF REINFORCED BODIES [O TEORII ARMIROVANNYKH TEL]
V. V. Bolotin 14 Sep. 1967 18 p refs Transl. into ENGLISH from Izv. Mekhan. Zhidkosti i Gaza. Akad. Nauk SSSR, no. 1, 1965 p 74-80
(AD-677212; FTD-HT-67-304) Avail: CFSTI CSCL 13/13

Equilibrium equations and boundary conditions are derived and investigated for bodies of a homogeneous isotropic elastic material reinforced with a large number of thin elastic rods of filaments. The content of the paper relates it to the authors work, which essentially analyzed the case of a body reinforced with a large number of flat parallel plates of higher rigidity. The initial assumptions on which the theory is based are formulated. The next two sections are devoted to derivation of the differential equilibrium equations and natural boundary conditions for reinforced bodies. The results are discussed. A conception of edge effects in reinforced bodies is then derived, and the limits of applicability of the theory are discussed. In the last section, equations that make it possible to take approximate account of the influence of local reinforcing element buckling are written. Author (TAB)

N69-14553*# National Aeronautics and Space Administration. Washington, D. C.
NASA SPACE VEHICLE DESIGN CRITERIA (STRUCTURES): PROPELLANT SLOSH LOADS
Aug. 1968 188 p refs
(NASA-SP-8009) Avail: CFSTI CSCL 20K

Sloshing of propellants may adversely affect the stability of a space vehicle and the integrity of the tank structure. Sloshing describes the free-surface oscillations of a fluid in a partially filled tank. These oscillations result from lateral and longitudinal displacements or angular motions of the vehicle. This undesirable sloshing phenomenon may be controlled by the proper geometrical design of the tank and by the addition of baffles. Tank geometry influences the natural sloshing frequencies and sloshing modes, forced response, and resultant pressure forces and moments acting on the tank. Baffles increase the effective fluid damping and thereby reduce the duration of free oscillations and the magnitude of forced oscillations. Dynamic coupling between the sloshing propellant and the elastic structure may have a large influence on the vibration frequencies and mode shapes of the elastic tank. This coupled propellant/elastic-tank system may also exhibit dynamic instabilities, either as an independent system or coupled with some other system component. This monograph is concerned primarily with the loads on the tank during lateral and longitudinal sloshing and with baffle pressure loads due to sloshing. Author

N69-14579# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.
IMPROVEMENTS TO LIQUID-NITROGEN LINES OF THE DIDO LIQUID-NITROGEN LOOP (JOB NO. 90583)
V. L. Fontaine, ed. May 1968 16 p refs
(AERE-M-2072) Avail: CFSTI; UK: 3s

Investigations are outlined of the reasons for low thermal insulation on the flexible liquid N_2 lines of the DIDO Liquid Nitrogen Irradiation Loop. Possible remedies are described, and the procedure for and results of the chosen remedy are reported. Author (NSA)

N69-14634 Wisconsin Univ., Madison.
ANALYSIS AND DESIGN OF SELF-OPTIMIZING VIBRATION DAMPER SYSTEMS
James Alec Bonesho (Ph.D. Thesis) 1967 180 p
Avail: Univ. Microfilms; HC $8.20/Microfilm $3.00 Order No. 67-16897

A brief summary of the classical theory of vibration reducing devices is presented and supplemented by a bibliography. Self-optimizing damper systems with one and two variable

parameters are considered. A control law is derived which states that the phase angle between the damper mass and the mass on which vibrations are to be minimized should be equal to 90° and that the damping in the self-optimizing damper should be equal to zero. The results of hybrid computer simulations which verify the theory are also presented. The design of a physical model is included and this design is generalized. Tests on this model are presented which show that the first two column resonances are eliminated by the application of this self-optimizing damper. Vibrations perpendicular to the force are also eliminated, as well as the effect of a higher harmonic. Improvements in the damper control circuit are suggested and further studies are indicated. Dissert. Abstr.

N69-14648# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

A NEW FAMILY OF LIFE DISTRIBUTIONS

Z. W. Birnbaum and Sam C. Saunders Oct. 1968 19 p refs *Its* Math. Note 576

(AD-677586; D1-82-0762) Avail: Issuing Activity CSCL 20/11

A new two parameter family of life length distributions is presented which is derived from a model for fatigue. This derivation follows from considerations of renewal theory for the number of cycles needed to force a fatigue crack extension to exceed a critical value. Some closure properties of this family are given and some comparisons made with other families such as the lognormal which have been previously used in fatigue studies. Author (TAB)

N69-14664# Argonne National Lab., Ill.

PROGRAM OF GEOMETRICAL RECONSTRUCTION FOR BIG BUBBLE CHAMBERS (VARIANT 1–6) [PROGRAMMA GEOMETRICHESKOI REKONSTRUKTSII DLYA BOL'SHIKH PUZYR'KOVYKH KAMER (VARIANT 1–6)]

N. F. Markova, V. I. Moroz, V. I. Nikitina, A. P. Stel'makh, and G. N. Tentyukova [1968] 16 p refs Transl. into ENGLISH of the Russian rept. JINR-P-10-3768

(ANL-TRANS-668) Avail: CFSTI

The program of geometrical reconstruction for big bubble chambers is considered which takes into account inhomogeneity of the magnetic field, ionization losses and multiple scattering. The bremsstrahlung for electrons and positrons and its fluctuations is also considered. All the formulas used are well founded. The track parameters are determined using the maximum likelihood method by minimizing the functional χ^2 which takes into account the multiple scattering matrix and the radiation, if necessary. The function includes the calculated trajectory-integral of the Lorentz equation in a real magnetic field with the account of the losses. A good choice of the initial approximation allows to limit oneself by the iteration only, according to the Newton method while determining the final parameters which reduce χ^2 to the minimum. Author (NSA)

N69-14676# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME PROBLEMS IN THE ZERO-MOMENT THEORY OF SHELLS MADE OF MATERIALS WITH DIFFERENT MODULI

S. A. Ambartsumyan et al 1 Dec. 1967 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR (Brevan), v. 43, no. 4, 1966 p 198–204

(AD-677218; FTD-HT-23-1091-67) Avail: CFSTI CSCL 13/13

The solutions of several problems concerning membrane-stressed shells, under external surface loading made of bi-modular materials, having different moduli (strengths) in tension and compression, are presented. The following equations used in solving these problems are taken from earlier works by the authors on the applicability of certain theorems of classical elasticity theory to bi-modular materials: equilibrium equations and geometrical strain-displacement relationships of the membrane theory of shells, and the generalized law of elasticity and formulas for direction cosines of tangential stresses uniformly distributed over the shell thickness. In each problem under discussion, the boundary conditions are established, and the formulas for determining the direction cosines, stresses, and displacement components are derived. The following sample analyses are carried out: (1) a circular cylindrical shell fixed at one end is subjected to combined tension and torsion by forces applied at the free end; (2) a frustum of a circular conical shell fixed at the small base is subjected to internal pressure combined with torsion by a tangential force applied at the large base; and (3) a shell having the form of a spherical zone under interval pressure is fixed at one face and twisted by a tangential force applied at the other face. In example (2), by means of passage to the limit, the corresponding results for a cylindrical shell can be obtained. Author (TAB)

N69-14699# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

LATTICE AND CONTINUUM THEORIES OF SIMPLE MODES OF VIBRATION IN CUBIC CRYSTAL PLATES AND BARS

R. D. Mindlin Aug. 1968 17 p ref

(Contract Nonr-4259(13))

(AD-677041; TR-11) Avail: CFSTI CSCL 20/2

With a view toward helping to bridge the gap, from the discrete side, between discrete and continuum models of crystalline, elastic solids, analytic solutions, in closed form, are obtained of the Gazis-Herman-Wallis finite difference equations of a simple cubic, crystal lattice for the cases of thickness-shear vibrations of a plate, face-shear and thickness-twist waves in a plate and axial shear vibrations of a rectangular bar. The simple character of the solutions facilitates detailed studies of frequencies and mode-shapes as the dimensions of the bodies and wave lengths increase from atomic to the macroscopic sizes at which the classical continuum theory may be used. Author (TAB)

N69-14726# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, e.V., Brunswick (West Germany). Institut fuer Flugzeugbau.

STRENGTH BEHAVIOR OF METAL-BONDED JOINTS WITH GLASS-CERAMIC ADHESIVES IN THE TEMPERATURE REGION FROM +20°C TO +650°C [FESTIGKEITSVERHALTEN VON METALLKLEBUNGEN MIT GLASKERAMISCHEN KLEBSTOFFEN IM TEMPERATURBEREICH VON +20°C BIS +650°C]

Walter Althof 1 Aug. 1968 75 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-51) Avail: CFSTI

Single lap joints and honeycomb-core panels of stainless steel were investigated in the temperature region from +20°C to +650°C. Performed were static short-time tests, long-time heating exposure, creep-rupture tests, and fatigue tests in the range for fluctuating stresses. As adhesive, a borosilicate glass, with metallic admixtures, was used. The mechanism of bonding between the glass adhesive and the adherent, and the mode of action of the metallic admixtures are explained by means of microphotography of the bond lines. The strength behavior of bonded joints with glass-ceramic adhesives is critically evaluated based on the test results. Author

N69-14758# Boeing Co., Renton, Wash. Commercial Airplane Div.

X-RAY DIFFRACTION STUDY OF THE EFFECT OF UNIAXIAL PLASTIC DEFORMATION ON RESIDUAL STRESS MEASUREMENTS

A. L. Esquivel 16 Sep. 1968 61 p refs Presented at 17th Ann. Denver X-Ray Conf., Estes Park, Colo., 22 Aug. 1968

(AD-677165; D6-23192) Avail: CFSTI CSCL 7/4

Uniaxial plastic deformation has been known to produce anomalies in residual stress measurements based on x-ray diffraction techniques. This study was undertaken to determine the magnitude of the effects, if any, on residual stress calculations from various materials subjected to UPD. An x-ray diffraction study using the two-exposure method was made on several iron, aluminum, and titanium alloys before and after these alloys were deformed plastically by bending on a U-bend test fixture. The x-ray peak shifts were recorded and the x-ray stress factors calculated by three different methods. These results are discussed together with observations on the additivity of residual and applied stresses, and the per cent differences in the stress measurements based on stress factors calculated by three different methods. Author (TAB)

N69-14767*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

NONDESTRUCTIVE TESTING. A DEMAND BIBLIOGRAPHY

12 Dec. 1968 10 p refs

(NASA-TM-X-61424; GP-613) Avail: CFSTI CSCL 20K

A listing of books and documents on nondestructive testing, prepared for use by the NASA space program, is presented. Author

N69-14795# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

ON THE DIFFUSION OF AN AXIAL LOAD FROM AN INFINITE CYLINDRICAL BAR EMBEDDED IN AN ELASTIC MEDIUM

Rokuro Muki and Eli Sternberg Sep. 1968 38 p refs

(Contract Nonr-220(58))

(AD-677474; TR-16) Avail: CFSTI CSCL 20/11

The investigation is concerned with the decay of the resultant axial force in an infinite cylindrical elastic bar that is completely bonded to an all around infinite elastic medium of distinct mechanical properties. The bar is subjected to an axial loading confined to, and uniformly distributed over, one of its cross-sections. First a solution to this problem, exact within classical three-dimensional elastostatics, is obtained for the special case of a circular cylindrical bar. Next, an approximative solution scheme applicable to a cross-section of arbitrary shape is developed. This scheme is subsequently used to deduce an approximate solution for the bar of circular cross-section. The exact and the approximate solution appropriate to the circular bar are compared with each other, particular attention being given to their asymptotic behavior near the load and at large distances from the applied loading. The present work is preliminary to an approximate treatment of the physically more important problem pertaining to the diffusion of load from a transverse tension-bar that is immersed to a finite depth in an elastic halfspace. In addition, the results established are of interest in connection with the study of fiber-reinforced materials. Author (TAB)

N69-14866*# Decision Science, Inc., San Diego, Calif.

TWO NEW METHODS FOR OBTAINING STABILITY DERIVATIVES FROM FLIGHT TEST DATA

George H. Burgin Sep. 1968 60 p refs

(Contract NAS4-1280)

(NASA-CR-96005) Avail: CFSTI CSCL 20K

Two new methods for obtaining control and stability derivatives from observed flight data are developed. The first method is based on a quasilinearization procedure and is applicable in parameter identification problems where the plant is modeled by a system of linear differential equations, and noisy measurements of state and control variables are available. Computationally, this method is equivalent to a modification of the Newton–Raphson method. The second, a "directed random search" method, is based on a concept called evolutionary programming, and is also applicable for nonlinear problems. Using X-15 flight test data, the two methods are compared and stability and control derivatives for the lateral motion of the X-15 are given. Author

N69-14933# National Aerospace Lab., Tokyo (Japan).

THE VIBRATION OF A T-SHAPE PLATES STRUCTURE

Taketoshi Hanawa, Tsuneo Tsuiji, and Shinichi Koshide 1968 42 p refs In JAPANESE; ENGLISH summary

(NAL-TR-159) Avail: CFSTI

The vibration of a plate structure is analyzed by the same procedure that was used in the analysis for a single plate. The in-plane and out-of-plane vibrations, in general, exist for these structures. Since it could be expected that the in-plane vibration occurs at very high frequency, only the out-of-plane vibration, the bending vibration, is considered in this report. This implies that in the analysis the stains in plates due to tension and compression can be neglected as small quantities compared to those due to bending. Experiments results, which were obtained by four kinds of specimens, are also compared with the analytical results. They were fabricated three ways: welding, mechanical jointing and bonding. Test results show that the method is applicable to analyze the vibration of structures consisting of plates. Author

N69-14945*# Midwest Applied Science Corp., Lafayette, Ind.

IDENTIFICATION OF LINEAR SYSTEMS. SIMULATION STUDIES Final Report, Feb. 1967–Apr. 1968

F. Kozin and C. H. Kozin Apr. 1968 204 p refs

(Contract NAS5-10106)

(NASA-CR-98738; MASC-RD-29F) Avail: CFSTI CSCL 20K

This study is concerned with the analytical development and with digital simulation experiments of a parameter estimation technique of practical significance for the identification of real systems. The result of the work is the proposal of a method for the identification of linear and nonlinear constant coefficient systems by random or sinusoidal excitations. The technique, based upon the principles of statistical expectations and time averages, requires knowledge of the displacements, velocities, accelerations, and input data of a system. From these data, such unknown parameters as the mass, spring, and damping factors can be determined by forming various moments, or time averages, of the system's input and dynamic output variables. The resulting linear equations in the unknown parameters are solved to yield the desired estimates. K.W.

N69-14948# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.

ON THE ANALYSIS OF STRUCTURES IMPACTED BY HYPERVELOCITY PROJECTILES

J. R. Vinson Aug. 1968 48 p refs

(TR-69) Avail: Issuing Activity

Consideration is given to the various data correlations which were made to obtain empirical equations for describing the penetration of projectiles into targets whose thickness can be considered semi-infinite. Also discussed are the mechanics of projectiles impacting thin targets, multi-wall targets, and targets protected by a plastic foam; impacting sandwich walls; spallation resulting from hypervelocity impact; and self-sealing systems for protection against the micrometeoroid hazard. The following equations are recommended for describing hypervelocity impact: (1) For impact into a target of semi-infinite thickness, use the Bouma and Burkitt cratering equation. (2) For impact into a target of finite thickness, use the Bouma and Burkitt cratering equation multiplied by a factor of 1.74. (3) For impact into a bumpered target, use the Wallace–Vinson–Kornhauser equation. (4) For impact into a target protected by plastic foam, use the Pipitone and Reynolds equation. (5) For impact into a finite thickness target to prevent spallation, use the Bouma and Burkitt cratering equation multiplied by a factor of 2.0 M.G.J.

N69-14958# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

ON THE NORMALITY OF THE CREEP FUNCTION DURING TRACTION TESTS OF A LIGHT-ALLOY AT 200°C [SUR LA NORMALITE DE LA FONCTION DE FLUAGE LORS D'ESSAIS DE TRACTION D'UN DURAL A 200°C]

R. Mazet 1968 31 p refs In FRENCH; ENGLISH summary Presented at the I.U.T.A.M. Symp. on the Thermo-Inelasticity, Glasgow, 26–28 Jun. 1968 Submitted for publication
(ONERA-TP-594) Avail: CFSTI

Constant speed traction tests, carried out at 200°C on aluminum alloy samples, are examined according to Hooke and Norton laws, and to a simplified theory of dislocations. Within a broad domain of stresses, the statistic distribution of creep thresholds follows a normal law of the Rayleigh type. The maximum interval breath condition is used to determine the permanent creep strain.
Author (ESRO)

N69-14998# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
SOLUTIONS OF THE EQUATIONS OF EQUILIBRIUM OF ELASTIC DIELECTRICS: STRESS FUNCTIONS, CONCENTRATED FORCE, SURFACE ENERGY
Jeremy Schwartz Aug. 1968 28 p refs
(Contract Nonr-4259(13))
(AD-677040; TR-10) Avail: CFSTI CSCL 20/11

Functions analogous to the Papkovitch functions of classical elasticity are derived for Mindlins linear theory of elastic dielectrics whose energy density of deformation and polarization depends on the gradient of the polarization, as well as on the strain and on the polarization itself. These functions are then used to solve the problems of the sphere and of the spherical cavity, in the absence of all external actions, in order to display the influence of surface curvature on the surface energy of deformation and polarization inherent in the theory.
Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N69-13920 Stanford Univ., Calif.
SHOCK TUBE STUDY OF THE THERMAL CONDUCTIVITY OF ARGON
Jackie Ondra Bunting (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-6396

The end-wall thermal boundary layer behind a reflected shock has been analyzed to determine the thermal conductivity of argon over the temperature range from 3150 to 9225°K. Pressures behind the reflected shock, assumed constant through the thermal layer, were chosen sufficiently high to suppress nonequilibrium and side-wall effects. Temperature profiles, computed from interferometric measurements of density, were compared with a numerical solution of the full nonlinear thermal boundary layer equations assuming a temperature dependence for thermal conductivity of the form $K \propto T^s$. Typically, 10 to 12 points were obtained in a thermal layer which was approximately 1.5 mm thick, with the nearest points approaching 0.2 mm from the wall. Refraction effects and related optical distortion precluded measuring closer to the surface.
Dissert. Abstr.

N69-14023*# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
THE EFFECT OF PERIODIC SHOCK-FRONTED PRESSURE WAVES ON THE INSTANTANEOUS HEAT FLUX AT THE END-WALL OF A TUBE
Raymond W. Goluba 1 Aug. 1968 138 p refs
(Contract NsG-601)
(NASA-CR-72443) Avail: CFSTI CSCL 20M

In measuring instantaneous heat flux rates, pressure oscillations with frequencies of 479 to 881 Hz, amplitudes up to 175 psi peak-to-peak, and average tube pressures from 40 to 190 psia were obtained. The heat flux was calculated from the surface temperature of the end-wall as measured by a thin platinum resistance film deposited on a Pyrex surface inserted into the end-wall. The instantaneous flux was found to be large compared to the time-averaged heat transfer rate. The instantaneous rates increased with increasing pressure ratio and were proportional to the square root of the product of the wave frequency and the time-averaged pressure of the oscillations. A one-dimensional model was solved numerically for the case of zero net heat transfer to the end-wall. The calculations agreed with the experimentally observed trends and correctly predicted the shape of the periodic portion of the flux.
Author

N69-14026# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FIFTH SCIENTIFIC CONFERENCE ON PROBLEMS OF EVAPORATION, COMBUSTION AND GAS DYNAMICS OF DISPERSION SYSTEMS
D. I. Polishchuk 8 Dec. 1967 12 p Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev) v. 11, no. 5, 1966 p 575–578
(AD-677515; FTD-HT-23-1078-67) Avail: CFSTI CSCL 20/13

The conference was divided into two sections: one on phase transitions in aerodispersed systems and the other on combustion and gas dynamics. At the planary session of both sections, 51 papers dealing with the theory and practice of the formation and stability of aerosols, heat exchange, and gas dynamics of two-phase flows and 58 papers on theoretical and experimental studies of combustion and evaporation of dispersed materials at high temperatures were presented.
Author (TAB)

N69-14032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLAME CONFIGURATION IN ENTANGLED STREAMS
V. A. Dvoynishnikov et al. 8 Dec. 1967 15 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR (Moscow), v. 11, no. 2, 1966 p 250–257
(AD-677514; FTD-HT-23-1080-67) Avail: CFSTI CSCL 21/2

A method was developed for calculating the flame configuration and the temperature field in a flame generated by a homogeneous, combustible gas jet of finite width discharging into a cocurrent infinite stream of combustion products. The problem was solved with a computer for an incompressible fluid using L. A. Vulis hypothesis (Issledovaniye fizicheskikh osnov rabochego protsessa topok i pechey, Izd. AN KazSSR, 1957) that the product rho.u eq.) (rho = density, u = velocity) is equal for compressible and incompressible fluids. The method was applied to determine the flame configuration of a 60 mm wide methane-air jet with an air excess coefficient of 1.07, an initial temperature of 473K, and a velocity of 46.5 m/sec discharging into a cocurrent flow of combustion products with a velocity of 22 m/sec and a temperature of 1873K. The latter temperature corresponds to the theoretical combustion temperature of the methane-air mixture. A graph of the temperature, velocity, and heat release across the boundary layer showed that combustion takes place in a narrow zone 10-16 mm wide. The maximum heat release does not occur at the maximum temperature but at about 1473K. Axial temperature and velocity profiles showed that the increases in temperature and velocity in the axial direction are less steep than in radial direction.
Author (TAB)

N69-14068*# Techtran Corp., Glen Burnie, Md.
THE MOVEMENT OF PARTICLES SUSPENDED IN FLUIDS AT REST WHICH IS POSTULATED BY THE MOLECULAR-KINETIC THEORY OF HEAT [UBER DIE VON DER MOLEKULARKINETISCHEN THEORIE DER WARME GEFORDERTE BEWEGUNG VON IN RUHENDEN FLUSSIGKEITEN SUSPENDIERTEN TEILCHEN]
A. Einstein Washington NASA Dec. 1968 11 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 17, 1905 p 549–560 (Contract NASw-1695)
(NASA-TT-F-12006) Avail: CFSTI CSCL 20M

Bodies suspended in fluids move so as to be visible under the microscope if they are large enough. The magnitude of the heat-induced movement, not yet experimentally observed, is calculated. Author

N69-14072# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM PHYSICS OF COMBUSTION AND EXPLOSION
4 Dec. 1968 23 p refs Transl. into ENGLISH from the Russian
(JPRS-47007) Avail: CFSTI

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2. DETONATING POWER OF PERCHLORATE EXPLOSIVES L. N. Akimova, L. N. Stesik, and A. Ya. Apin p 9–18 refs
(See N69-14074 04-33)

N69-14073# Joint Publications Research Service, Washington, D. C.
COMPUTING PRESSURES FOR SHOCK-WAVE INITIATION OF HOMOGENEOUS EXPLOSIVES
I. M. Voskoboynikov, V. M. Bogomolov, and A. Ya. Apin *In its* Transl. from Phys. of Combustion and Explosion 4 Dec. 1968 p 1–8 refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (Novosibirsk), no. 1, Jan.–Mar. 1968 p 45–49 (See N69-14072 04-33)
Avail: CFSTI

Homogeneous explosions, initiated by a shock wave are considered to be adiabatic. The critical pressures for initiating an adiabatic explosion of homogeneous explosives are computed using the equation of state of the molecular crystal, assuming that in the process of shock compression the molecules are not deformed. The monomolecular disintegration velocity constant was assumed to be independent of the degree of compression, and hence the molecular decomposition kinetics is constant under different pressures. The temperature at the shock front was found using the combined solution of the equation of preservation of energy and the isotherm equation. The dependence of temperature on pressure on the shock adiabate is shown for a number of explosives. B.P.

N69-14074# Joint Publications Research Service, Washington, D. C.
DETONATING POWER OF PERCHLORATE EXPLOSIVES
L. N. Akimova, L. N. Stesik, and A. Ya. Apin *In its* Transl. from Phys. of Combustion and Explosion 4 Dec. 1968 p 9–18 refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (Novosibirsk), no. 3, Sep. 1967 p 386–392 (See N69-14072 04-33)
Avail: CFSTI

Results of experimental investigation are presented on the size of the critical diameter of detonation of ammonium perchlorate (APC) based mixtures in relation to the density of the charge and the particle size of the components. To determine the critical diameter, cylindrical charges were exploded and the passage to the detonation was recorded using a streak camera. The charges were encased in cellophane 0.05 mm thick. In all investigated density ranges the critical detonation diameters of mixtures with a non-explosive combustible lie below the same characteristics of the oxidant, and the critical detonation velocities lie above. This fact led to the conclusion that an interaction between the oxidant and the combustible took place, resulting in an additional evolution of energy and, consequently, in an increase of the temperature in the zone, which in its turn accelerates the process of decomposition of the oxidant. The critical diameter of the explosives increases with increasing particle size as seen from the data. B.P.

N69-14081# Technische Hochschule Munchen (West Germany). Institut fuer Technische Thermodynamik.
INFLUENCE OF THE GEOMETRY AND MATERIAL PROPERTIES OF THE HEATING SURFACE ON THE BOILING CRISIS IN THE FREE CONVECTION [EINFLUSS DER GEOMETRIE UND DER MATERIALEIGENSCHAFTEN DER HEIZFLAECHE AUF DIE SIEDEKRISIS BEI FREIER KONVEKTION]
D. Finck Mar. 1968 106 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-68-05) Avail: CFSTI

Previous equations and their derivations are compiled for the maximum heat flux (boiling crisis, burnout, or critical heat flux) with pool boiling in a saturated liquid. By examining approximately 700 previous measurements combined with nearly 2400 new test results for the maximum heat flux, distinct effects of the geometry and properties of the heating surface are disclosed. Interpretation of the phenomena was made difficult owing to the considerable scatter which occurred with repeated tests under otherwise identical conditions. The influence of some parameters is described by a model consisting of a heating element with a uniform spatial heat source distribution and local adiabatic surfaces. The behavior of the vapor bubbles adjacent to the heating element with various geometries at the maximum heat flux condition is described with the aid of photographs. Author (NSA)

N69-14152# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORMATION OF THE GAS FLOW BEFORE THE FLAME FRONT
G. D. Salamandra 14 Dec. 1967 10 p refs Transl. into ENGLISH from Russian
(AD-677254; FTD-HT-23-1233-67) Avail: CFSTI CSCL 21/2

A study was made of the deflagration to detonation transition in hydrogen-oxygen mixtures using high-speed photography (94,000 frames/sec). Data were obtained on the gas flow in the quiescent medium before the flame front by introducing artificial optical inhomogeneities into the quiescent gas mixture, and then photographing their traces. These traces were then transformed into distance vs time diagrams. Plots of the flame speed vs time were also obtained. A comparison of the experimental data with data calculated by the method of characteristics showed that the state of the gas before the flame front can be calculated by this method. It was also shown that when the flame front moves with accelerated motion, the gas velocity, density, and pressure attain their maximums very close in front of the flame front. Author (TAB)

N69-14171*# Stanford Research Inst., Menlo Park, Calif.
COMPARATIVE EVALUATION OF ABLATING MATERIALS IN ARC PLASMA JETS
Nevin K. Hiester and Carroll F. Clark Washington NASA Dec. 1968 197 p refs
(Contract NASr-49(15))
(NASA-CR-1207) Avail: CFSTI CSCL 20M

In a round-robin ablation study, Teflon and high-density phenolic-nylon models were evaluated at various enthalpies and heating rates under supersonic conditions. These two high-density materials were evaluated at stagnation pressures up to 10

atmospheres for the former and 30 atmospheres for the latter. The effect of model size was also evaluated using both hemispherical and flat-faced Teflon models having effective radii varying from one-quarter to four times the radius used previously. The mass loss rates again correlated with the results from the earlier study, except that high-density phenolic-nylon models showed a rapid increase in ablation above a stagnation pressure of about 2.6 atmospheres. These higher rates were also correlated, and found to agree, with literature data for these same pressure regime. Five new low-density materials—Langley phenolic-nylon, Hughes phenolic-nylon, Avcoat epoxy-novalac-filled honeycomb, Langley silicone elastomer, and General Electric silicone elastomer—were also studied at enthalpies from 2500 to 34,000 Btu/lb and stagnation pressures from 0.004 to 2 atmospheres. Mass loss rates, front surface, and internal temperatures were measured for these materials. Author

N69-14188 North Carolina Univ., Chapel Hill.
A STUDY OF SIX- AND NINE-POINT FINITE DIFFERENCE ANALOGUES OF THE ONE-DIMENSIONAL HEAT EQUATION
John Minor Gwynn, Jr. (Ph.D. Thesis) 1967 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-2182

A discussion of finite difference analogues to the one-dimensional heat equation centers around three major concepts, convergence, stability, and truncation error is presented. Two apparently different types of convergence, convergence(I) and convergence(II), and two types of stability, stability and uniform stability are defined. Easily applied necessary and sufficient conditions for the stability and uniform stability of the six-point and nine-point analogues are then obtained. It is shown that stability and uniform stability are equivalent for the six-point analogues. The equivalence of uniform stability, convergence(I), and convergence(II) for the interesting six-point and nine-point analogues is proved. Representation theorems are proven which show that each useful six-point or nine-point analogue, whose truncation error is of sufficiently high order, is one of the interesting analogues to which one of the equivalence theorems applies. It is also shown that, for each useful nine-point analogue except one, stability and uniform stability are equivalent. Dissert. Abstr.

N69-14307# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ON A HEAT AND MASS TRANSFER PROBLEM WITH TWO MOVING BOUNDARIES
J. C. Y. Koh, J. F. Price, and R. Colony Sep. 1968 47 p refs
Its Math. Note 575
(AD-677110; D1-82-0759) Avail: Issuing Activity CSCL 22/2

The heat and mass transfer problem in a passive transpiration cooling system involving two moving boundaries is formulated. A numerical calculation scheme and computer program are developed to solve the problem. Computations are performed for the case of porous tungsten infiltrated with copper exposed to an environment of high pressure and high heat flux. The effects of porosities and the radius of curvature on the thermal response and infiltrant recession are shown. Author (TAB)

N69-14422# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF DERIVATIONS OF THERMAL IGNITION THEORY TO DETERMINE THE GENERAL FLAME STABILIZATION CONDITION WITH A BLUFF BODY
V. A. Mironenko 5 Dec. 1967 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 1, 1966 p 140-145
(AD-677215; FTD-HT-23-1066-67) Avail: CFSTI CSCL 21/2

In solving the problem of flame stabilization, it is necessary to consider equally both the flow structure behind the bluff bodies and the kinetics of the chemical reaction. The article demonstrates, however, that, with certain assumptions and simplifications, the blow-out characteristics of a flame holder in the form of a bluff body can be satisfactorily explained and calculated, by using the thermal theory of ignition and the theory of turbulent flow. In deriving quantitative correlations, the following assumptions were made: (1) Up to the ignition point, the velocity, temperature, and concentration distributions of the turbulent boundary layer behind the holder are in accordance with the theory of turbulent flows for nonisothermal counter flows; they are not changed by the heat release resulting from the chemical reaction, for, according to the thermal theory of ignition, during the period of ignition delay, the heat release and temperature rise are insignificant. (2) The static pressure in the boundary layer behind the holder is equal to the free-stream static pressure. An expression was derived to determine the effect on the blow-out characteristics of the combustion chamber of the physical flow parameters (pressure, flow velocity, temperature) and type of fuel. If the dependence of the length of the reverse-flow zone on the dimension and shape of flame holder are known, the effect of its geometric parameters may also be determined. Author (TAB)

N69-14501*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT MEASUREMENT OF OPTICAL RADIATION FROM SHOCK-HEATED AIR BY USING A TRAILBLAZER 2 VEHICLE
Lloyd S. Kester, Jr. and Ernest F. Burcher Washington Dec. 1968 46 p refs
(NASA-TN-D-4937) Avail: CFSTI CSCL 22C

A flight measurement of optical radiation from shock-heated air was obtained by using a Trailblazer II vehicle. Observations in two spectral bands were made near the stagnation point of a high-velocity (6 km/sec) body at extremely high altitudes (80 to 55 km). The reentry body configuration and the reentry velocity allowed observations of nonequilibrium radiation effects not previously measured in flight. Severe truncation and collision limiting were experienced. The measurement results were compared to analytical predictions and previous experiments. The experiment results complemented those from Project Fire and those from ground-based investigations and can be applied to the problem of reentry heating and to the evaluation of the concept of optically detecting and tracking noncooperative reentry vehicles. The measurement technique used in this experiment, because of its simplicity, may be applicable to other reentry experiments. Author

N69-14528 Pittsburgh Univ., Pa.
RADIATION AND CONVECTION FROM EXTENDED SURFACES
Richard Charles Donovan (Ph.D. Thesis) 1967 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-4393

The radiative and convective heat transfer from a fin-array consisting of longitudinal rectangular fins on a plane surface was analytically investigated. The interaction among the heat conduction in the fin, the convective heat transfer to the fluid medium, and the radiant exchange of the fin with the neighboring elements was examined, the problem mathematically formulated and numerical solutions obtained in order to achieve the following primary objectives: (1) the evaluation of the total heat transfer from the fin ensemble to determine the effectiveness of the extended surfaces, (2) the evaluation of the individual contributions of radiation and convection to determine the effectiveness of each, and (3) the influence of the important parameters on the thermal performance of the fin-array. The governing mathematical relations for this physical process are a set of five nonlinear integro-differential equations and were solved by a numerical iterative method on a digital computer. Dissert. Abstr.

N69-14582# Bureau of Mines, Washington, D. C.
RESEARCH AND TECHNOLOGIC WORK ON EXPLOSIVES, EXPLOSIONS, AND FLAMES: FISCAL YEAR 1967
Information Circular
Aug. 1968 28 p refs Prepared in cooperation with the Dow Chem. Co. and Mfg. Chemists' Assoc., Inc.
(AD-677727; BM-IC-8387) Avail: CFSTI CSCL 19/1

The principal activities of the Bureau of Mines Explosives Research Center during fiscal year 1967 (July 1, 1966, to June 30, 1967) are reviewed in part 1. Part 2 presents short abstracts of the publications issued during this period in the Bureau series and in other media. Part 3 describes a short study on the shock initiation of hydrogen peroxide not destined for publication elsewhere. Author (TAB)

N69-14588*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
HEAT-TRANSFER COEFFICIENTS FOR HYDROGEN FLOWING THROUGH PARALLEL HEXAGONAL PASSAGES AT SURFACE TEMPERATURES TO 2275 K
Jack G. Slaby and William F. Mattson Washington Dec. 1968 25 p refs
(NASA-TN-D-4959) Avail: CFSTI CSCL 20M

Local forced-convection heat-transfer data are presented for hydrogen flowing through an electrically heated test section composed of 19 hexagonal parallel passages with a length- to equivalent-diameter ratio of 63.5. The data cover ranges of surface-to hydrogen-temperature ratios from 1.43 to 3.38, bulk Reynolds numbers from 12,950 to 21,960, surface temperatures to 2275 K, and outlet hydrogen temperatures to 747 K. The results are correlated in terms of Nusselt, Prandtl, and modified Reynolds numbers. The data fell within about ±20 percent of the correlating equations. The heat-transfer results agreed with those obtained from a parallel flat-plate test section with similar dimensions. Author

N69-14604# Union Carbide Nuclear Co., Oak Ridge, Tenn. Computing Technology Center.
RANKIN: A SUBROUTINE FOR THE CALCULATION OF THERMODYNAMIC PROPERTIES ALONG RANKINE CYCLES
Robin E. Textor 10 Sep. 1968 16 p refs
(Contract W-7405-ENG-26)
(CTC-2) Avail: CFSTI

In order to accommodate a fairly wide range of thermodynamic problems in which Rankine cycles (or slight variations thereof) appear, a subroutine was written which controls the calculation of thermodynamic properties and heat at the points of interest of such a cycle for which known information, such as enthalpy and entropy, can be utilized in any form convenient to the user. A listing of the subroutine (written in IBM Fortran IV language) is included. NSA

N69-14606#
ON THE ROLE OF SCATTERING IN RADIATION HEAT EXCHANGE PROCESSES
V. N. Adrianov [1969] 8 p refs Transl. into ENGLISH from the book "Teploobmen, Gidrodinamika i Teplofizicheskie Svoistva Veshchestva" Moscow, Nauka Press, 1968 p 139–145
Avail: CFSTI

The role of scattering in radiation heat exchange processes is investigated analytically for symmetric forward–back and isotropic scattering indices. A differential–difference approximation system of equations considered the radiation heat exchange process of an isothermal plane layer of absorbing and scattering gas and solved for the spectral surface densities of the incident and effective radiations. The transmissivity, reflectivity, and absorptivity of the plane layer were then determined. B.P.

N69-14691# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.
MECHANICAL VIBRATION—A DRIVING MECHANISM FOR COMBUSTION INSTABILITY IN ROCKET ENGINES
P. D. Mc Cormack and S. Birch Oct. 1968 25 p refs
(Grant AF-AFOSR-1101-66)
(AD-677594; AFOSR-68-2356) Avail: CFSTI CSCL 21/8

A far-field analysis and experimental investigation of the mixing of a gas jet in the presence of a vibration driven source of periodic vorticity at the orifice was completed. The main claim made is that the vibration driven vortices form the large eddy component of the turbulent far-field mixing region. Also that these eddies predominate at the outer edges of the jet and are responsible for the increased rate of spreading angle. This leads to an effectively increased eddy coefficient of viscosity. Hot-wire investigations of the far-field velocity problem tend to confirm this. An experimental investigation of liquid jets in the presence of vibration - produced pressure variation at the orifice, revealed the oscillatory pressure profiles expected on the basis of vortex rings in the jet. The intense localized vorticity near the jet surface, it is claimed, will endow droplets atomized from such regions with considerable angular momentum (spin). An initial analytical investigation which attempts to predict the effect of droplet spin on evaporation rates was completed. Author (TAB)

N69-14781# European Space Technology Center, Noordwijk (Netherlands).
THE CONVERSION OF MEASURED HEAT FLUXES INTO THE AVERAGE RADIATION INCIDENT ON CURVED SHAPES
J. Doenecke Paris ESRO May 1968 30 p refs
(ESRO-TN-26(ESTEC)) Avail: CFSTI

The derivation of formulae for transforming measured radiation intensities into values which are normally incident on a convex satellite surface in a test chamber are dealt with, the position and orientation of the satellite being arbitrary. The method given is also valid of the chamber is provided with several windows for the entry of solar beams. The equations are first derived for cones, but are presented in a form which can also be applied for any rotationally symmetrical body. As a limiting case the equations are applicable for segments of circular or annular surfaces. The intensity measurements can be made either in the chamber's reference plane or in other planes at points lying on the surface of the satellite during the test. The appendix, in which calculations are given for the ESRO I satellite, illustrates the method. Author (ESRO)

N69-14801# Oak Ridge National Lab., Tenn. Reactor Div.
TCDATA: A FORTRAN PROGRAM FOR COMPUTING THERMODYNAMIC DATA OF COMPOUNDS IN ANY PHASE STATE
M. H. Fontana Sep. 1968 45 p refs
(Contract W-7405-ENG-26)
(ORNL-4304) Avail: CFSTI

A code written for the CDC 1604 in Fortran 63 may be used to compute the following thermodynamic data as a function of temperature: specific heat, entropy, free energy function, enthalpy of formation, free energy of formation, and the $\log_{10}$ of the equilibrium constant of the particular compound in question as formed from its elements in their standard state at that temperature. The format of the tabulated data is similar to that used for the JANAF thermochemical tables. A sample calculation was performed for SrO (gas) and compared with independently published data. Author (NSA)

N69-14802# Oak Ridge National Lab., Tenn. Reactor Div.
ONE PHASE: A SIMPLIFIED FORTRAN 63 PROGRAM FOR COMPUTING TABLES OF THERMODYNAMIC DATA FOR COMPOUNDS IN ONE PHASE
M. H. Fontana Sep. 1968 17 p refs
(Contract W-7405-ENG-26)
(ORNL-4307) Avail: CFSTI

A simplified Fortran program was written to compute thermodynamic properties using specific heat equations, and the entropy and the heat of formation at some known temperature. The program computes and prints tables of the following properties: specific heat, enthalpy, entropy, heat of formation, free energy of formation, and the equilibrium constant of formation. Cards may be punched directly for use by computer programs requiring data input in this format. Author (NSA)

N69-14817# National Bureau of Standards, Washington, D. C. Inst. for Basic Standards.
THERMODYNAMIC PROPERTIES OF AMMONIA AS AN IDEAL GAS
Lester Haar Aug. 1968 17 p refs Repr. from J. Res. Natl. Bur. Std., A., v. 72A, no. 2, Mar.–Apr. 1968
(NSRDS-NBS-19) Avail: Issuing Activity

Thermodynamic functions for ammonia as an ideal gas at one atmosphere pressure have been evaluated. The contribution of the highly anharmonic out-of-plane vibrational mode, including its large coupling with rotation and its coupling with the other vibrational modes, is considered in detail. Author

N69-14821# Fiat S.P.A., Turin (Italy).
FORCED CONVECTION BURNOUT AND HYDRODYNAMIC INSTABILITY EXPERIMENTS FOR WATER AT HIGH PRESSURE. PART 5: ANALYSIS OF HEATING AND BURNOUT EXPERIMENTS IN A DOUBLE CHANNEL TEST SECTION, WITH TRANSVERSELY VARYING HEAT GENERATION
G. P. Pozzi, G. Previti, and P. Sala Brussels EURATOM Sep. 1968 112 p refs
(Contract EURATOM-008-61-12 PNII)
(EUR-4070-e) Avail: CFSTI

The analysis of some heating and burnout tests performed in a double channel test section has been performed. The calculation method used in this analysis was a digital program that solves the mass, energy and momentum equations of a mono- (or two) phase fluid in a tridimensional domain. First some heating tests with no bulk boiling have been analyzed: the calculation outlet temperature distribution in the various subchannels has been compared with the experimental outlet temperature distribution. Next a systematic analysis of the burnout tests has been performed, with different heating on the burnout rod, on the adjacent rod and on the shell. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N69-14324# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLANNING RESEARCH AND DEVELOPMENT AND EXPERIMENTAL DESIGN WORK
M. L. Bashin 28 Dec. 1967 140 p refs Transl. into ENGLISH of the book "Planirovaniye Nauchno-Issledovatel'skikh i Opytno-konstruktorskikh Rabot" Moscow, Ekonomik, 1966 p 1–216
(AD-677022; FTD-HT-23-1247-67) Avail: CFSTI CSCL 5/1

The problems of planning scientific research (henceforth research and development) and experimental design work have not as yet been satisfactorily illuminated in the economic literature. The book by M. L. Bashin is an attempt to correlate the experience in planning and accounting of the leading research and development and design organizations of those machine-building and instrument-making industries which are now profit-oriented. This experience pertains to planning and accounting of research and development and experimental design work. The book examines the sequence of developing and approving long-range and annual project plans, typical project stages, methodology of topic project planning, and calculations of the labor time which goes into the work and production estimates. It also illuminates the problems of planning the work of programming departments, laboratories, pilot plants, information services of research institutes and design offices. The book utilizes the available instruction materials. TAB

N69-14449# Congress. Senate. Committee on Aeronautical and Space Sciences.
TENTH ANNIVERSARY OF THE COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES, 1958–1968
1968 109 p refs *Its* 90th Congr., 2d Session, Senate Doc. no. 116
Avail: SOD

The purpose of this document is to set forth the historical background and record of the Senate Committee on Aeronautical and Space Sciences during the first decade of its existence. The document describes the jurisdiction and procedures, legislative record, membership, and staff assistance. Included also are the National Aeronautics and Space Act of 1958, as amended, related legislation, and the Communications Satellite Act of 1962. Author

N69-14492*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY, JULY 1966–JUNE 1967: A BIBLIOGRAPHY
Royal L. Woods, comp. 15 Dec. 1967 68 p refs
(Contract NAS7-100)
(NASA-CR-91826; JPL-BIB-39-8) Avail: CFSTI CSCL 22

This is a compilation of official reports of the Jet Propulsion Laboratory released during this period. Abstracts are presented of technical reports and memorandums, of summaries of space programs, and of engineering and scientific articles which appeared in the open literature. K.W.

N69-14618# National Science Foundation, Washington, D. C.
FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND OTHER SCIENTIFIC, FISCAL YEARS 1967, 1968, AND 1969, VOLUME 17
[1969] 268 p refs
(NSF-68-27-VOL-17) Avail: Issuing Activity

The report covers federal research and development support to every kind of performer, by character of work, by field of science, and by agency. Federal funding is also reported for scientific and technical information activities and for the collection of general-purpose scientific data. Characteristics, levels, and trends of federal funding are indicated. Data are presented in tables and graphs. K.W.

N69-14686# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
DETECTION OF GAS LEAKS BY MEANS OF RADIOACTIVE TRACERS [DETECTION DES FUITES DE GAZ AU MOYEN DE TRACEURS RADIOACTIFS]
A. Bruna, P. G. Caldera, G. Ageleo (Palermo Univ.), and G. Benincasa (Palermo Univ.) Sep. 1968 36 p In FRENCH
(Contract EURATOM-092-65-10-IRAI)
(EUR-4056F) Avail: CFSTI

Presented is a critical and comparative study of the methods of detecting leaks in gas mains using respectively methyl bromide labelled with Br-82 and a sodium chloride aerosol labelled with Na-24. This study was based on tests of the first method and certain preliminary data on the second. It is proposed that radioactive

isotopes in the form of a gas and even of an aerosol of a labelled salt be used for the detection of gas leaks in underground mains. A short comparison will be made at the end of the study. The present report describes the research carried out with a view to improving the method of detecting leaks by means of an $Na^{22}Cl$ aerosol. Author

N69-14687# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
STUDY OF A METHOD OF FIXING THE METHYL BROMIDE USED FOR DETECTING LEAKS IN GAS MAINS [ETUDE D'UN SYSTEME DE FIXATION DU BROMURE DE METHYLE UTILISE POUR LA DETECTION DES FUITES DANS LES RESEAUX DE DISTRIBUTION DU GAZ] Final Report
P. G. Caldera, F. Pavesio, and A. Bruno Oct. 1968 57 p refs In FRENCH
(Contract EURATOM-092-65-10-IRAI)
(EUR-4065F) Avail: CFSTI

This report contains a description of the experiments carried out to investigate a method of fixing radioactive methyl bromide (Br 82-labelled) which is used for detecting leaks in town gas mains. This method is based on the elimination of the gas tracer, by absorption or adsorption in selective filters, before the gas reaches the user. It has the advantage of not requiring the gas supply to be interrupted while leaks are being traced. A wide-ranging search of the specialized literature led to several chemical compounds which act as absorbers or adsorbers being tested, such as monoethanolamine, triethanolamine, pyridine and various types of active carbon. The most promising results were obtained with the active carbon Active-carbone NC 8/16. The type of filter developed, which is positioned in the rising column, was tested in trials carried out both in the laboratory and in sections of underground pipe. Mixtures of methane and methyl bromide and of town gas and methyl bromide were used for this purpose. In addition tests were carried out to assess the diffusion of methyl bromide in premises where gas is consumed. Author

N69-14926# European Space Research Organization, Paris (France).
ESRO/ELDO BULLETIN NUMBER 3
Nov. 1968 46 p Partly in FRENCH and partly in ENGLISH Prepared jointly with ELDO
Avail: CFSTI

CONTENTS:

1. THE F-7 LAUNCH OF EUROPA-1 p 4-8 (See N69-14927 04-31)

2. THE EUEOPEAN SPACE CONFERENCE H. Lindner p 9-10 (See N69-14928 04-34)

3. THE EUROPEAN SPACE RESEARCH INSTITUTE H. L. Jordan p 11-19 (See N69-14929 04-34)

4. ELDO MINISTERIAL CONFERENCE p 21-35 (See N69-14930 04-34)

5. PROGRESS IN OPERATIONAL PROGRAM p 36-43 (See N69-14931 04-31)

N69-14928# Bundesministerium für Wissenschaftliche Forschung, Bad Godesberg (West Germany).
THE EUROPEAN SPACE CONFERENCE
H. Lindner *In* ESRO/ELDO Bul. No. 3 Nov. 1968 p 9-10 In ENGLISH (See N69-14926 04-34)
Avail: CFSTI

The main features and aims of the European Space Conference (E.S.C.) are recalled and an outlook on matters of discussion in the November meeting in Bonn, i.e. coordination and reorganization of European space programs is given. ESRO

N69-14929# European Space Research Inst., Frascati (Italy).
THE EUROPEAN SPACE RESEARCH INSTITUTE [L'INSTITUT EUROPEEN DE RECHERCHE SPATIALE]
H. L. Jordan *In* ESRO/ELDO Bul. No. 3 Nov. 1968 p 11-19 In FRENCH (See N69-14926 04-34)
Avail: CFSTI

Describes the structure of the European Institute of Space Research (ESRIN) and gives details of its research program, the purpose of which is to integrate theoretical interpretations of satellites and terrestrial observatory data with laboratory experiments. A theoretical group, equipped with computer simulation facilities, deals with theoretical aspects of plasma physics related to the magnetosphere, the solar corona and the ionosphere. Experimental programs comprise laboratory simulation of solar and magnetosphere plasma, studies on plasma resonance and studies on collisionless plasmas in shock tubes and the working out of new techniques in atmospheric physics. ESRO

N69-14930# European Space Vehicle Launcher Development Organization, Paris (France).
ELDO MINISTERIAL CONFERENCE
In ESRO/ELDO Bul. No. 3 Nov. 1968 p 21-32 In FRENCH and ENGLISH (See N69-14926 04-34)
Avail: CFSTI

The Press Conference held in October 1968 by the Chairman of the second session of the Conference of Ministers responsible for space affairs of member countries of the European Launcher Development Organization (ELDO) and the resolutions voted upon by the Conference are presented. ESRO

N69-14937# European Space Research Organization, Paris (France).
ESRO/ELDO BULLETIN NUMBER 2
Aug. 1968 44 p refs Partly in FRENCH and partly in ENGLISH Prepared in cooperation with ELDO
Avail: CFSTI

CONTENTS:

1. SCIENTIFIC RESEACH AT THE EUROPEAN SPACE RESEARCH LABORATORY V. Manno, D. E. Page, A. Pedersen, W. Steinmann, and E. A. Trendelenburg p 4-10 (See N69-14938 04-23)

2. NETWORK ANALYSIS—CONTRIBUTION TO THE ELDO MANAGEMENT I. Stevenson p 11-17 (See N69-14939 04-34)

3. DATA HANDLING IN THE DIVISION OF ENVIRONMENTAL TESTING AT ESTEC P. E. Muller p 18-20 (See N69-14940 04-08)

4. ELDO MINISTERIAL CONFERENCE p 24-28 (See N69-14941 04-34)

5. PROGRESS IN OPERATIONAL PROGRAM (See N69-14942 04-31)

N69-14939# European Space Vehicle Launcher Development Organization, Paris (France).
NETWORK ANALYSIS—CONTRIBUTION TO THE ELDO MANAGEMENT [L'ANALYSE DE RESEAU—CONTRIBUTION A LA GESTION DU CECLES]
I. Stevenson *In* ESRO ESRO/ELDO Bull. No. 2 Aug. 1968 p 11-17 In FRENCH (See N69-14937 04-34)
Avail: CFSTI

The network for the ELDO management planning and program control was divided into three levels of detail: network level 1 comprises a general summary of the ELDO programs as a whole; network level 2 is established by the governmental organization and allows for planning and control from one week to the next; network level 3 is established by the contractors and is used for day-to-day project management. Some examples of the computer

analysis of the ELDO PERT network are given and the problems of communication between Member States and Secretariat, necessary for the updating and the analysis of the central network, are outlined. ESRO

N69-14941# European Space Vehicle Launcher Development Organization, Paris (France).
ELDO MINISTERIAL CONFERENCE
In ESRO/ELDO Bull. No. 2 Aug. 1968 p 24-28 In FRENCH and ENGLISH (See N69-14937 04-34)
Avail: CFSTI

The ministers responsible for space affairs in the ELDO Member States met in Paris in July 1968 to examine proposals which had been drawn up following a review of the Organization's programs made necessary by the expected overspend. The resolution of this conference is given. ESRO

N69-14955*# National Aeronautics and Space Administration, Washington, D. C.
TECHNOLOGY UTILIZATION, USA—TRIP REPORT [NUTZBARMACHUNG NEUER TECHNOLOGIEN USA—REISEBERICHT]
H. Kolodziej Nov. 1968 25 p Transl. into ENGLISH of the German Rept. GfW-AB-68/1, Jun. 1968 26 p
(NASA-TT-F-11882; GfW-AB-68/1) Avail: CFSTI CSCL 05A

Information on NASA's Technology Utilization Program is summarized with the object of applying the experience gained from visiting various U.S. installations to developing a similar program in Germany. Specific suggestions on organization, operation, methods, services, and problems of the program for Germany are made. B.P.

N69-14968*# Syracuse Univ., N. Y.
EDUCATION FOR PUBLIC SERVICE—CHALLENGE TO THE UNIVERSITIES
John C. Honey [1968] 16 p refs
(Contract NASr-206)
(NASA-CR-98704) Avail: CFSTI CSCL 05K

Discussed are university programs for professional education as it relates to public service within the United States. Growing evidence points to the increasing difficulty in coping with the demands made upon the nation if the educational system fails to produce the manpower required by public service. Curricula in professional schools should give special attention to those elements which bear on an understanding of the public service, the professional's role in it and the career opportunities with special educational opportunities such as internships, seminars, work-training assignments, study, travel, etc. G.G.

N69-15015*# George Washington Univ., Washington, D. C.
PROGRAM OF POLICY STUDIES IN SCIENCE AND TECHNOLOGY Annual Report, 1967-1968
L. H. Mayo [1968] 91 p refs
(Grant NGL-09-010-030)
(NASA-CR-98708) Avail: CFSTI CSCL 05A

An overview is presented on the continuing and prospective activities of the program designed to increase the University's policy research capability and to stimulate thought and new activities on questions involving the science-society interface. The research development application process continues as a primary area of concern, along with the policy problems involved in advancing civilian technology. The institutional response mechanism is discussed together with criteria for selecting challenges which are both intellectually stimulating and with which the Program has a capability to deal. It is felt that definite progress was made in the development of a multi-disciplinary, problem-oriented approach to policy studies. Revised concepts are examined in terms of a shift toward establishing and maintaining operational arrangements with non-University participants, and the need for assembling interdisciplinary problem-oriented groups. Summaries are provided on the study reports which pertain to technology assessment, technological innovation, institutional response, and the application of modern R and D management concepts and skills to social and urban programs. M.G.J.

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